

# The Chemical Age

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**NOTICES.**—All communications relating to editorial matter should be addressed to the Editor, who will be pleased to consider articles or contributions dealing with modern chemical developments or suggestions bearing upon the advancement of the chemical industry in this country. Communications relating to advertisements or general matters should be addressed to the Manager.

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## Dyestuffs and Fine Chemicals

LOOKING back on the past year or so, can it be said that the progress made in the two branches of chemistry which the nation desires to develop—dyestuffs and fine chemicals—is satisfactory? The answer is both "yes" and "no." Progress there has undoubtedly been in production, in research, in commercial organization. We are now making a great many products not made in this country before, and a great organization has been built up which was not in existence formerly, or at least on anything like the present scale. On all these sides we are moving from smaller to much bigger things, and that is certainly progress. If, on the other hand, one judges alone by the number of things yet undone, or by imperfections in detail, or by the number of mistakes made in attempting new undertakings, then the answer might be in the negative. But the fair way is to judge rather by the positive results than by the extent to which the results fall short of ambitions. If medical science, for example, were judged solely by the volume of disease it had failed to cure, we should say it was a dismal failure. It is not judged in that purely negative way; we are thankful for what, in spite of its limitations, it is able to do in the struggle with disease. And if we take as our test what is being done to-day that was not done ten or even five years

ago it must be admitted that both in dyestuffs and in fine chemicals we stand already far ahead of where we stood when Europe was plunged in war. That can only be described as real progress.

In the matter of dyestuff production, the contrast between our position to-day and our position in 1914 is really rather striking. Before the war there were a number of concerns which were doing excellent work. But it could hardly be said that we had a national dyestuff industry. Now we have one. The fact that it is criticised so much is the most convincing proof, for even the cleverest person cannot criticise what does not exist. Let us grant at once that it is not yet all it might be and ultimately will be, that in the hurry in which the business was started and developed mistakes were made, that if we had to do it all over again with plenty of time we should do it differently. What, after all, is this but the record of all human effort? Everyone who looks back on his own career sees the sins of omission and commission, which cannot be recalled. Every Sunday a great proportion of our fellow-creatures publicly confess that they have done things they ought not to have done and left undone things they ought to have done. It is considered quite the proper thing to do. So when wise people, looking back on the history of the modern dyestuffs industry, point out mistakes which, with our present experience we should probably not repeat, they are merely indulging in a platitude—what they say of the dyestuffs industry is true in just about the same degree that it is true of every human undertaking, individual or collective. But since we all feel a bit better for pointing out other people's failings the habit persists.

It is better, we think, to judge of positive results. Here the evidence is substantial. Most of the concerns that produced dyestuffs before the war are still carrying on, and in most cases have extended their operations. Several successful new firms are at work. The B.D.C., which is more singled out than any other because it represents the national industry, is gradually overcoming its great difficulties. The range of dyestuffs produced is now remarkably large. More remarkable still, as a proof of progress, is the fact that the quality of British dyestuffs is to-day rarely if ever questioned; the controversy is narrowed down to the question of price. More research, it is true, is demanded, but research cannot be carried out without money. Nor can any other public work. The Federal Council which proposed to raise half-a-million a few years ago is now content to go in for a useful ten thousand. Nobody denounces the Council for having to "cut" its plans. Nor is the Corporation to be blamed for curtailing schemes which it cannot afford, regrettable as the necessity for such curtailment may be.

Similarly, the Development Committee has to recognise financial limitations, in the absence of which

much more might have been done. The Licensing Committee is less criticised by importers than it was at the outset, and some sort of tentative understanding has been come to with merchants. We have never overlooked the dangers of a protective system, one of the chief of which is the temptation to rely on artificial aids instead of on internal vitality and initiative, but without the temporary protection of the Dyestuffs Act, the British dyestuffs industry would have had no fair chance of getting its footing. It may be that before long, the old Free Trade controversy may once more become the dividing line in British politics. But the principle behind the Dyestuffs Act was one to which practically all parties agreed as a matter of national necessity. A review of all these conditions seems to us to justify satisfaction at the results achieved rather than discontent over incidental mistakes.

Much less has been heard of fine chemicals than of dyestuffs because the industry is less a subject of controversy, but it is satisfactory to learn from many sources that it is going forward well. Of the increase in the number of products, figures taken from the output of one firm are a sufficient indication. Where 100 products were produced before the war, 1,400 are being produced to-day, while the increase in bulk production is in the proportion of  $2\frac{1}{2}$  tons to-day to one ton before the war. The proportions in this case are too high, no doubt, to be taken as an average, but everywhere there is progress, though in different degrees. The difference between the increase in total output and the increase in the number of products shows how largely the new products are fine chemicals needed in only small quantities—so small, indeed, that their production would be commercially unprofitable except as units of one great industry. In such matters one sees the point of the fine chemical producers' argument—that the fine chemical industry must be treated as an organic whole, and not as a collection of unrelated odds and ends. From the public point of view it is the possession of a completely equipped industry that is more important even than the particular products turned out; we have seen the value of such organisation in the readiness with which the production of a new and invaluable substance like insulin has been successfully undertaken. The accounts one hears of business are good. Several firms report themselves to be very busy. The explanation is probably twofold. The quality of British fine chemicals is coming to be recognised as thoroughly dependable; the demand for them is increasing because competitive sources are drying up.

Looking fairly over the position, some remarkably good work has been done in the last few years, the results of which are now beginning to appear. What is wanted to complete the business is co-operation and constructive work—and less purely negative fault finding.

### Valuation of Imported Chemicals

A POINT of some importance, we understand, has arisen between the Customs authorities and firms who import chemicals as to the basis on which the goods should be taxed under Part I. of the Safeguarding of Industries Act. In the ordinary way a c.i.f. invoice would be accepted as representing the actual market value of

imported goods, since it represents the actual price paid by the importer, and would be accepted as the basis for levying duty. The Customs authorities have usually acted on this view, and continued to do so, we believe, until recently, when cases were discovered in which the c.i.f. invoice was found substantially to understate the actual sale price of the imported goods. The device of understating the value with a view to reducing the amount of duty does injustice in two directions—it deprives the State of revenue to which it is entitled, and it places the honest importer at a disadvantage. The result is the issue of a circular instructing dock officers to scrutinise all invoices submitted by importers and to refer to the Customs headquarters in London all cases in which the invoice value appears to be below the fair market price.

To these measures, in so far as they relate to invoices which are not *bona fide* and are designed to assist in the detection of attempts to evade the payment of just duty, no objection can be taken. But there may be some danger of the Customs authorities pressing it beyond this point. Even where the genuineness of the invoice is not disputed they may say that the invoice figure—that is, the actual purchase price—is below the current market price here, and claim the right to fix what they consider to be a fair market price and levy duty accordingly. The question may arise whether Part I. of the Act gives the Customs authorities this right to assess the value themselves and to ignore the invoice value, even when it is admitted strictly to agree with the actual price paid. The point is one of considerable importance to large importing firms, as it would become unsafe to adopt a selling price on the basis of the invoice value if the latter is liable to be amended in accordance with an official valuation. Negotiations, we believe are now proceeding on the point, and there is some feeling in favour of taking a test case if the Customs authorities hold that their own valuation must supersede the invoice value for duty purposes.

### Potash and Waste Heat Recovery from Cement Kilns

IN this country very little seems to have been done in the way of recovering potash from the dust of cement kilns; but, as we have previously pointed out, nearly a score of plants for the purpose are in operation in America. Renewed interest is attached to the process, so far as this country is concerned, by the announcement that a new method of effecting recovery has been taken up by a firm of engineers whose name is a household word in industrial circles over here. In addition to removing the dust, the new process presents possibilities in the way of utilising waste heat for steam-raising purposes.

The inventor of the process points out that experiments with his system have shown that with certain grades of raw material some of the dust from the kilns will collect in caked form on hot surfaces, and that this caked material contains potash salts and other ingredients which make it valuable. It is, therefore, important to collect as much as possible of this caking material, as it may be sold at a much higher price than the finished cement. The part of the dust adhering

or caking to the hot surfaces has a different chemical composition from the rest of the dust which will not so adhere. It is, therefore, possible to effect a separation of the dust having the caking characteristics from the remainder of the dust, thus recovering a valuable by-product from the cement kiln dust. The caked material is removed from the walls by means of scrapers. From the primary collecting flue the hot gases are led through a heat-absorbing device in the shape of a waste-heat boiler. Here a considerable reduction in the temperature of the gases is effected; accordingly their volume and velocity are likewise reduced and separation of the remainder of the dust is facilitated. The inventor states that because of the cooling of the gases in this way the dry dust separators beyond the boiler have gases of less velocity to handle. Moreover, the washers through which the gases subsequently pass, operate much more satisfactorily on the cooled gases, as very hot gases tend to evaporate and carry away the spray water in the form of steam, and interfere with the satisfactory operation of the washer generally. Also, the cooled gases are much more readily handled by the fan. In cases where the final removal of the dust is effected by electrical means, the reduction in temperature of the gases is of great advantage.

The process is of interest if only for the fact that it may be the means of attracting renewed attention to a problem which, like its intimate associate the recovery of potash from blast-furnace gas, has never yet in practice been tackled with any great enthusiasm in this country.

### British Artificial Silk

THE paper read last week before the Textile Institute at Leicester on the British Artificial Silk Industry by Mr. P. E. King draws attention to one or two facts in connection with this subject which have not been generally appreciated. Of the four commonly manufactured varieties of artificial silk two are largely made in this country, and of all the countries producing artificial silk, Great Britain comes second, the United States being first. The number of difficulties in the various processes has been very great, but these appear now to have been altogether overcome and the artificial product is used in very large quantities for making fabrics of various kinds, either mixed with natural silk or cotton, or alone. The producers of natural silk may conceivably be unable to find any market for their goods in the near future as a result of this development. It must be remembered that artificial silks are the first attempt at synthetic fibres, and the future possibilities of other such fibres to replace wool, cotton, etc., at the moment, though not definite, would seem to be unlimited. Strictly, of course, only the Viscose and Celanese products are synthetic fibres, others being more or less altered cotton, but these are actually the two forms which seem to be making the most headway at the moment, and which are manufactured in Great Britain in large quantities. One is justified in feeling proud that this country is so well to the front in the development and use of artificial silks.

### Points from Our News Pages

Special articles in this issue include: "The Utilisation of Dyestuffs as Antiseptics," by Mr. S. E. Ellingworth (p. 444); "Some Modern Methods of Producing Esters," by Dr. S. P. Schotz (p. 446); and "The Chemistry of the Sesquiterpene Group," by Mr. Cecil Hollins (p. 452). An Interview with Mr. J. A. Brewin, Prime Warden of the Dyers' Company, is given (p. 449). Abstracts are published of two papers read at the meeting of the Textile Institute at Leicester, dealing with the "Application of Dyes to Textile Fibres," by Professor Jocelyn Thorpe (p. 452); and "The British Artificial Silk Industry," by Mr. P. E. King (p. 454). According to our London Market Report, the outlook is better this week (p. 467). Business in the Scottish chemical market has again been quiet during the past week, according to our special report (p. 470).

### Books Received

- L'INDUSTRIE DU GAZ DISTILLATION DE LA HOUILLE. Par René Masse et Auguste Baril. Paris: Masson & Cie et Gauthier Villars & Cie. Pp. 296. 20 fr.  
L'INDUSTRIE DU GAZ TRAITEMENT DES PRODUITS ET SOUS-PRODUITS. Par René Masse et Auguste Baril. Paris: Masson & Cie et Gauthier Villars & Cie. Pp. 308. 20 fr.  
THE STEAMING OF WIGAN ARLEY COAL IN VERTICAL GAS RETORTS. Technical Paper No. 8. By the Fuel Research Board. London: H.M. Stationery Office. Pp. 18. 9d.  
ORGANIC CHEMISTRY FOR ADVANCED STUDENTS. By Julius B. Cohen. London: Edward Arnold and Co. Part I.—Reactions. Pp. 423. 18s. Part II.—Structure. Pp. 461. 18s.

### The Calendar

October		
29	University of Birmingham Chemical Society: "Perfumes." Mr. F. J. Corby. 5.30 p.m.	Birmingham.
30	Hull Chemical and Engineering Society: "British Made Dyes for Paints and Distempers." Mr. G. B. Shaw. 7.45 p.m.	Hull Photographic Society's Rooms, Park Street, Hull.
31	Chemists' Dinner under the joint auspices of the Society of Chemical Industry, the Chemical Society and the Institute, 7.30 p.m.	Hotel Victoria, Northumberland Av., London, W.C.2.
31	Society of Chemical Industry (Newcastle Section): "Milk." Mr. H. R. Whitehead. 7.30 p.m.	Chemical Lecture Theatre, Armstrong Newcastle-on-Tyne.
Nov. 1	Chemical Society: Ordinary Scientific Meeting. 8 p.m.	Burlington House, Piccadilly, W.1.
1	Society of Dyers and Colourists (West Riding Section): Paper by Mr. James Southcombe.	Bradford.
2	Joint Meeting of Manchester Sections of the Society of Chemical Industry, Institute of Chemistry, Society of Dyers and Colourists, and the Manchester Literary and Philosophical Society. "Electrometric Methods in Analytical Chemistry." Professor W. D. Treadwell. 7 p.m.	Textile Institute, Manchester.
7	Society of Public Analysts: Papers by Dinshaw Rattonji Nanji, William S. Shaw, Phyllis H. Price, W. Donovan, and J. C. Thresh. 8 p.m.	Burlington House, Piccadilly, W.
10	Finsbury Old Students' Association: Annual Dinner. 7 p.m.	Engineers' Club, London.
23	Chemical Industry Club: Annual Dinner.	Connaught Rooms, London.



## The Utilisation of Dyestuffs as Antiseptics

By S. Ellingworth, M.Sc.

*The dye manufacturer has long been intimately concerned with the production of medicinal chemicals. The utilisation, however, of dyestuffs themselves for disinfectant and antiseptic purposes, the subject of the following article, represents a sphere of scientific activity even yet at an early stage of development, and may in the future result in a further extension of a profitable "side-line."*

### The Function of Antiseptics

It may be as well at the outset to consider what is required of an antiseptic or disinfectant substance, and also the conditions under which it must perform its work. Disinfectants, first of all, possess the power of inhibiting the growth of bacteria, whereas antiseptics are able in addition to effect the complete sterilisation of infected regions.

The destruction of the organisms may have to be carried out under widely varying conditions. For example, it may be required to apply the antiseptic to a surface wound, or in a surgical operation, or even internally, or in the veins and tissues. It therefore follows that the substance must be capable of exerting a selective action in attacking and destroying the invading disease germs, whilst being at the same time comparatively harmless to the host. Its toxicity should have a low value, and interference with the natural healing processes should not occur at the concentrations required for sterilisation.

Difficulty has frequently been experienced owing to the fact that whereas a substance may show considerable activity against bacteria in watery media, much higher concentrations may be necessary in a medium of blood serum—i.e., the efficiency of the antiseptic is much reduced by those conditions under which it must act when applied to a wound. It is therefore necessary to take into account these considerations when testing compounds for their bactericidal properties.

The use of dyestuffs as germicides is, of course, not new. In the course of his search for substances capable of destroying parasites without affecting the host, Ehrlich and his pupils observed that the organisms were killed by a considerable number of dyestuffs, which at the same time selectively stained the living protozoa. Quite a remarkable analogy has been drawn between the body action of these substances and their behaviour in the ordinary process of fabric dyeing.

According to the theory of Witt, the colour of a compound is due primarily to the presence of certain groupings, termed "chromophores," such as  $C=C$ ,  $C=O$ ,  $C=N$ ,  $N=N$ ,  $N=O$ ,



Such substances, however, are not necessarily dyestuffs; dyeing properties require, in addition, the presence of salt-forming groups, usually  $NH_2$  or  $OH$  (known as "auxochromes"), by which the substance may be firmly held to the fibre.

In the same way Ehrlich considered that a drug contains first an active group, or "pharmacophore," but must also possess an "anchoring" group, corresponding to the "auxochrome," by which the substance can attach itself to and exert its action on the body cells.

### Dyeing of Nerve Tissues

The dyeing of nerve tissues has led to the suggestion of a further analogy between the process of dyeing and the action of a poison injected into the body. Thus, the fibres of the living tissue are supposed to extract the colouring matter from its solution and fix it, in much the same way as does an ordinary fabric, by reason of its greater affinity for the dyestuffs. Most nerve dyes can be extracted from their aqueous solutions by means of ether, owing to their greater solubility in that solvent. This is not the case, however, if a sulphonic acid group be introduced into the molecule, the solubility of the substance in water being much increased. At the same time the property of staining the nerve tissues is lost with the advent of the acid group. Hence it is supposed that the tissues play the part of the ether in the ordinary extraction, and therefore become subject to the action of the dyestuff or drug.

In connection with the theory of "anchoring" groups, it is certainly a curious and significant fact that amino and hydroxy groups, which are the most common "auxochromes" in dyestuffs, also appear to play the most important part of all groupings in the physiological action of organic compounds.

Another interesting observation possibly connected with

the bactericidal action of coloured substances was made by Raal, who found that strongly fluorescent bodies greatly increased the action of sunlight on organisms, whilst in the dark they were almost inert. A 1 in 20,000 solution of acridine killed infusoria exposed to sunshine in six minutes. In the dark they lasted for 24 hours. Similar results were observed with quinine and eosin, from which it was inferred that the effect was due to fluorescent rays. Such observations suggest that the action of dye solutions as antiseptics may not be unconnected with their action on the light rays transmitted by them.

It must be admitted, however, that the whole question of the mode of action of these bodies is still very little understood, and although reasonably certain explanations may have been offered in particular cases, no theory can be regarded as even approaching a satisfactory generalisation.

### Dyestuffs in Medicine

Mention may now be made of some of the dyestuffs which have found application in medicine by reason of their bactericidal or parasitocidal properties. In their search for compounds of the latter class, Ehrlich and his pupils found that tetrazo colours derived from naphthalene 3-6 disulphonic acid, as well as a number of azo colours, and basic dyes of the triphenylmethane series were all effective.

Amongst the last-named group malachite green, brilliant green, methyl violet and crystal violet have all found application in medicine, and exert, in addition to their parasitocidal action, the powerful effect against bacteria of true antiseptics. Methylene and toluidine blues, safranin, and certain of the auramines have also been employed in surgery and in cases of malaria.

Malachite green, injected into the blood, has been stated to destroy trypanosoma in 48 hours, whilst Lelean claimed (*Lancet*, May 3, 1902) that methylene blue, with atropine and benzoic acid, was the only drug he found to be effective against *Bilharzia*.

Picric acid has, as is well known, found considerable favour as a specific for burns, a 1 per cent. solution being rapidly fatal to bacteria and spores. Its irritant and poisonous properties, however, as well as the yellow stains to which it gives rise, are disadvantageous.

In connection with the remarks previously made regarding fluorescent substances, it is interesting to note that fluorescein was patented as an antiseptic by Turpin (Fr. Pat. 346,363, 1904), chiefly for use in toilet preparations. Halogenated derivatives, such as eosin, are said to show still greater activity.

Phenol phthalein is employed in medicine as a purgative, merely acting as an irritant. It is almost the only synthetic substance used for this purpose. Again, the halogenated derivatives are stated to exert a similar action.

### Applications in Surgery

It has been remarked that a number of dyestuffs have found application in surgery. All the substances so far mentioned, however, possess the great disadvantage that their antiseptic potency is greatly reduced by the presence of blood serum, and therefore, for effective application to wounds, considerably greater concentrations must be employed than those ordinarily sufficient for sterilisation. This, of course, allows the substance to exert a more pronounced effect towards the host, since, after all, the differentiation between organism and tissue is merely a selective action towards different kinds of protoplasm, and germicidal power must always be considered in relation to other physiological properties.

Of considerable importance, therefore, was the discovery of the flavine antiseptics. Both proflavine (diamino acridine sulphate) and acriflavine (diamino acridine methochloride) possess the valuable property of exerting enhanced bactericidal action in presence of serum. Thus it is not surprising that, despite their costliness, these substances have found considerable application during recent years for the treatment of wounds, and are also being utilised more and more extensively in cases of gonorrhoea. They are usually employed in the



form of a 0.1 per cent. or 0.2 per cent. solution, or as an ointment.

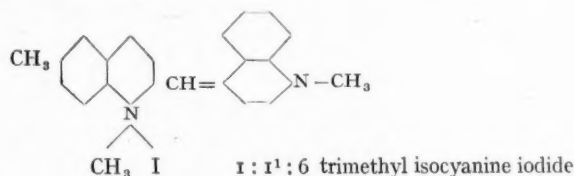
It has been demonstrated (Browning, Cohen, Gaunt and Gulbransen, *Proc. Roy. Soc. B.*, Vol. 93 (1922), 329) that a concentration as small as 1 in 200,000 is fatal to *Staphylococcus Aureus*, and 1 in 100,000 to *B. Coli*, these being two typical organisms selected for testing purposes.

Moreover, the toxicity of these substances is low, and healing processes do not appear to be in any way retarded.

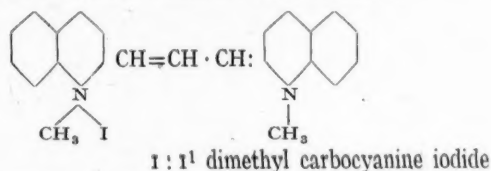
Quite recently the action of a large number of dyestuffs towards bacteria and protozoa was examined (Fairbrother and Renshaw, *Journ. Soc. Chem. Ind.* (1922), 134 T.). The highest dilutions employed were 1 in 5,000 in the case of the former, and 1 in 20,000 in the latter series of tests, though certain mixtures of dyestuffs were stated to have killed paramoecia in 15 minutes at a dilution of 1 in 160,000. The most effective colouring matters were the auramines, oxazines (paramoecia and gram positive organisms only), and the tri-phenyl methane dyestuffs, the results thus confirming previous observations with respect to the activity of these groups. No account appears to have been taken of toxicity and other physiological properties.

Certain special types of dyestuffs, hitherto employed solely for photo-sensitising purposes, have recently been shown to possess powerful antiseptic properties, as was briefly mentioned by the present writer in a previous article (*CHEMICAL AGE*, September 8 and 22, 1923).

Certain members of the isocyanine group, notably 1:1'6 trimethyl isocyanine iodide,



have been found to destroy *Staphylococcus Aureus* in a concentration of 1 in 200,000 to 1 in 400,000, whilst solutions of 1 in 40,000 to 1 in 100,000 have been shown to be fatal to *B. Coli*. Like the flavine antiseptics, these substances do not suffer diminution of their bactericidal power in the presence of blood serum. The carbocyanines, of which 1:1'1 dimethyl carbocyanine iodide is a typical example,



also display considerable activity against *Staphylococcus*, but are curiously inert towards *B. Coli*.

Still another class of colouring matters which possess photo-sensitising properties, namely, the dimethylamino styryl quinolines, act also as powerful antiseptics. Concentrations of 1 in 200,000 to 1 in 1,000,000 are fatal to *Staphylococcus* in media of both peptone water and ox serum, whilst *B. Coli* requires concentrations of 1 in 100,000 to 1 in 200,000 for complete sterilisation. (Browning, Cohen, Ellingworth and Gulbransen, *Brit. Med. Journ.*, August 25, 1923.)

A curious fact has been observed in studying these substances in that certain chemical groupings appeared to have a similar effect on both photo-sensitising power and antiseptic activity.

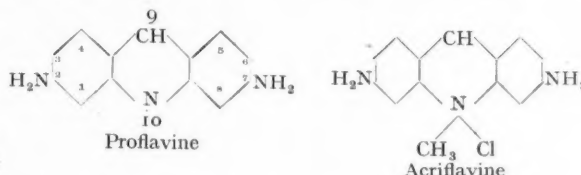
#### Photo-Sensitising Compounds

Up to the present time these photo-sensitising compounds have not yet found practical application in medicine, but their study is being continued, particularly with regard to general physiological action, and in view of the very powerful antiseptic properties of many members of these groups they may in the future form a not unimportant development in the realm of medication by dyestuffs.

In conclusion, we may consider briefly the question of chemical constitution related to antiseptic action as evidenced

by the foregoing dyestuffs. A very comprehensive study of a large number of acridine and phenazine compounds has been recently carried out by Browning, Cohen, Gaunt and Gulbransen (*loc. cit.*), all of which substances, it should be noted, contain the basic nitrogen of the pyridine ring.

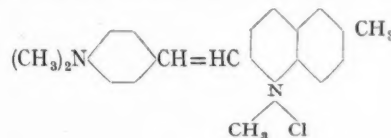
Introduction of amino groups into the 2:7 positions of the acridine molecule, as in proflavine, very definitely increased the antiseptic power.



Such compounds were especially effective in serum, the quaternary alkyl chlorides, of which acriflavine is an example, possessing this characteristic in a very marked degree. The substitution of alkyl in the amino groups appeared to have a depressing tendency, whereas the antiseptic action was almost abolished by the introduction of acidic groups, such as acetyl, carboxyl, and hydroxyl.

In the phenazine series, the quaternary compounds, such as the methochlorides, appeared to be superior to the hydrochlorides, but here the introduction of amino groups did not produce the same increase in activity as in the acridine series.

Fairbrother and Renshaw (*loc. cit.*) confirmed the observations of the above workers regarding the depressing effect of acidic groups, and also stated that the absence of amino groups is sufficient to prevent any decided antiseptic action. Alkyl substitution in the amino groups or in the benzene nuclei was said to modify the action of these groups. In view, however, of the powerful bactericidal properties of certain cyanines which contain no amino groups (though they do contain basic nitrogen in another form), and of substances such as *p*-dimethylamino styryl, 6-methyl quinoline methochloride, which is alkyl substituted in both the amino group



and a benzene nucleus, these postulates cannot, strictly speaking, be regarded as of general significance.

The presence of basic nitrogen, however, though not necessarily in the form of  $\text{NH}_2$  groups, is noticeable in all these powerfully antiseptic colouring matters, and in the cyanines and styryl quinolines there exists throughout a similar structure consisting of two basic nitrogen atoms, one saturated and the other unsaturated, connected by a chain of conjugate double linkages. In the case of the styryl quinolines, introduction of further amino groups into the quinoline nucleus certainly did not enhance the antiseptic potency.

It has to be admitted that so far we have touched merely the fringe of this question. Definite connections between chemical constitution and physiological action may be observed in particular types of compounds, but such relations do not yet appear to be anything like general. It is possible, and even probable, moreover, that physiological action is intimately connected with purely physical properties, themselves not yet comprehensively correlated with chemical constitution, and it would therefore appear that the day is still far distant when we shall be able to synthesise a substance which will definitely produce a desired physiological effect. When it is further considered that substances may differ widely in their activity towards the many different infections, it will be realised that the task of producing a universal antiseptic, which, according to newspaper advertisements, already exists, is but little easier than that of the alchemists in their ancient quest for a universal solvent.

It is only through much patient investigation, involving a wide and many-sided study of organic compounds, that future progress can be expected.

## Some Modern Methods for Producing Esters

By S. P. Schotz, D.Sc., F.I.C.

*The manufacture of esters is probably the oldest section of synthetic organic chemistry which has been carried out on a large scale, in which pure compounds of definite composition have been employed and the contemporary knowledge of organic chemistry and physico-chemical laws fully utilised. The production of these compounds now embraces huge branches of chemical technology, such as, for example, gun-cotton, celluloid and artificial silk.*

THIS article is confined to the simpler organic esters, which afford good opportunities for illustrating the leading ideas. A remarkable property of esters, as a class, is that many of these substances possess a very pronounced, pleasant smell, and, although from time to time theories have appeared which tried to establish a connection between chemical constitution and aromatic properties, yet so far no other group can be said to impart such a pleasant odour as this combination. Apart from this case we are yet very remote from defining so-called aromatophore groups and configurations.

The characteristic smell of many plants and flowers is frequently due to esters or their combinations, and one could almost say the knowledge of these substances is as old as mankind itself. In the analytical determination of minute quantities of these compounds we have certainly not advanced farther than the primitive man, for we are able even now to determine by the odour, with certainty, traces of esters, the presence of which the whole Committee of the Society of Public Analysts would not be able to prove by chemical means. Nature has no doubt very definite aims in supplying plants with a typical aroma. Frequently it is meant to attract insects to assist fertilisation, or birds to carry the seeds. The peculiar fragrance of certain orchids is probably intended to attract insects on which they partly subsist.

### Industrial Considerations in Ester Manufacture

By far the largest quantities of esters are still being produced from alcohols and acids, and the principles involved continue to be based on the laws established by Berthelot and Péan de St. Gilles on one hand and Guldberg and Waage on the other. As far as science is concerned the whole matter resolves itself into a question of equilibrium and mass action. However, when we desire to exploit any process for industrial purposes, a number of other highly important factors have to be taken into consideration. Such are the cost of each constituent, the price of their most accessible derivatives, cost of plant, labour, power, fuel and the time taken by a complete cycle of operations. The expense of the additional substances, i.e., catalysts or dehydrating agents, has also to be taken into account. If all these data had to be collected before producing esters, probably none of these compounds were to be had at present. Nevertheless, it is not very difficult to establish a convenient working formula. Unfortunately, it would take us too far to discuss here even the simplest laws from which they could be derived. Perhaps it will be best and most interesting to take a few examples and explain by means of these what modifications in the manufacture have been or could be effected.

If we mix equimolecular quantities of pure ethyl alcohol and acetic acid, i.e., 46 parts by weight of alcohol and 60 of acid, we find that a reaction occurs, ethyl acetate and water are produced, 66.6 per cent. of the starting materials being transformed.

Practically the same point of equilibrium is attained at whatever temperature esterification is carried out, 200° C. making only a difference of about 2 per cent. However, it takes a considerably longer time at lower temperatures than in the heat. Berthelot found the following values:—

At ordinary temperatures.....	10 years
At 100° C. ....	200 hours
At 170° C. ....	42 "
At 200° C. ....	24 "

If we increase the proportion of alcohol we find that the yield of ester also increases, and becomes 100 per cent. calculated on the acid, when 50 molecules of alcohol are used for one of acid, i.e., 2,300 parts of alcohol for 60 of acid. That, of course, would be quite unpractical. Fortunately, the same result can be obtained with the aid of catalytic agents and quite a small excess of alcohol. This is really the key of many of the leading methods of making esters, both in the laboratory

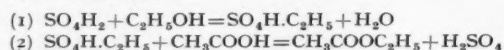
and on a commercial scale. Sulphuric and other acids are the most common catalysts.

For a long time it used to be considered that the dehydrating action of sulphuric acid was mainly responsible for the esterification, and that catalytic effects played a subordinate rôle. Recent investigations disprove this view. If 56 parts of alcohol are treated with 50 parts of acetic acid and 4 to 9 parts sulphuric acid dissolved in 50 parts of water, from 88 to 92 per cent. of the theoretical yield of ethyl acetate are obtained (Bodroux).

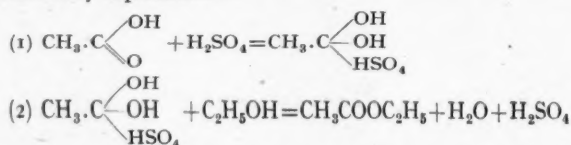
Attempts have therefore been made to utilise salts of sulphuric acid instead of the acid itself. In a beautiful investigation of Senderens and Aboulenc, which was published last year, potassium bisulphate and anhydrous aluminium sulphate were made use of. However, the results are in general much poorer than those obtained with the aid of sulphuric acid.

### Theory of Esterification

Although chemical theories serve their purpose best when they summarise the results of a long series of practical experiences, very often a time arrives when the experimental material is far too complicated, made up of too many factors and too unwieldy for a definite simple conclusion. In that case speculations which are capable of embracing the whole mass of facts become of paramount importance. Williamson's theory of ether formation has long been thought to afford a clue to what is happening if, say, ethyl alcohol, acetic acid and vitriol are mixed, it being contended that the following reactions occurred:—



This would no doubt explain why potassium bisulphate and anhydrous aluminium sulphate are not such efficient catalysts as sulphuric acid. However, esterification with  $\text{H}_2\text{SO}_4$  can be carried out at temperatures at which reaction (2) does not take place. Bodroux has therefore modified Williamson's equation in the following manner, which might afford a satisfactory explanation:—



Owing to the immense variation in properties of organic compounds the actual mode of carrying out this reaction has to be varied in innumerable little ways. This characteristic of organic chemistry keeps one's interest continually alive. Very often even quite simple compounds demand great ingenuity if high yields and purity are the object. Take, for example, ethyl tartrate and observe what difficulties it has presented to various investigators, till it was finally prepared in excellent yield last year by Lowry and Cutter. We are not going to describe here this preparation, as we do not wish to deprive the reader of the pleasure of perusing the original paper in the *Journal of the Chemical Society*. We may, however, disclose that one of the main improvements was the utilisation of a rotating autoclave. Mechanical means play a very great part in many chemical manufactures, and by perfecting these often superior results are attained. What student of organic chemistry does not know the importance of having very thin sodium wire for the preparation of ethyl aceto-acetate? Of course, this can only be had through the use of efficient presses. When esterifying compounds which are not mutually soluble, very thorough mixing and disintegration lead to excellent results. So, according to Plauson, cellulose acetate and cellulose formate are much more easily formed from their components if the reaction is carried out in the colloid mill.

That, of course, is what one would expect, as the continuous increase of surface exposes fresh points for attack. Probably ethyl aceto-acetate could be easily prepared in such a machine, even by starting from metallic sodium in lumps.

### Methods of Manufacture

**Method I.**—The old-fashioned method of making ethyl acetate usually starts with grey acetate of lime, thus saving on the cost of raw material. This is mixed with about a 30 per cent. excess of rectified spirit. Sufficient of concentrated sulphuric acid is now added to set free the acetic acid and to leave about 5 per cent. of uncombined vitriol in the solution. The mixture is refluxed for two hours in a suitable acid-resisting container. The product is then distilled by means of open steam till the distillate shows no trace of organic compounds. Ethyl acetate, an aqueous solution of alcohol and a little acetic acid are obtained. The ethyl acetate is separated and freed from any alcohol by washing it first with soda solution, then with a little water, and is finally fractionated. The alcohol is recovered from the aqueous distillate and washings by the usual methods. The yields are about 95 per cent. calculated on the available acid. The disadvantages of this process are the following:—(1) The process is discontinuous; (2) some alcohol is lost by the action of sulphuric acid; (3) the sulphuric acid is mostly a total loss; (4) the use of sulphuric or other mineral acid means considerable wear to the plant, which in consequence demands a good deal of trouble in up-keep.

### An Improved Method

**Method II.**—From the point of view of modern chemical industry the greatest weakness of the first process is its intermittent nature. This means duplication of plant, excessive labour, loss of fuel in heating up and cooling down at frequent intervals, cleaning apparatus after each batch, etc. Many attempts have therefore been made to make of the process a continuous operation, while at the same time employing a mixture similar to that used in Method No. 1. Quite a few attempts to solve this problem are described in the Patent Literature, the actual way differing mainly in the construction of the apparatus and other points of detail. To illustrate the leading ideas we append the outline of a recent patent which appears to embody most of the progress that has been made in this special branch of continuous operation. The alcohol, acid and vitriol are mixed in a pre-heating arrangement to allow sufficient time for partial esterification to take place. The mixture is then allowed to flow along a system of pipes heated to a temperature sufficient to complete the esterification. It then enters a column provided with baffles. To the top of the column is fixed a fractionation still-head. The esterified mixture flows down the column and is met from below by a blast of open steam. The ethyl acetate, alcohol, acetic acid and most of the water distil over and the weakened sulphuric acid runs out at the bottom. The whole lay-out of this apparatus, and indeed of any other constructed on the same principle, is of necessity extremely complicated, and therefore very expensive to install and costly to maintain. It is certainly an improvement on Method I, and where a very large production of acetic ester is required it should prove very useful.

### The Use of Sulphonic Acids

**Method III.**—When we review Methods I and II we find that all difficulties are occasioned by the employment of concentrated sulphuric acid, which becomes weak and ineffective in the course of the reaction and has to be removed, to be replaced by fresh material. If we try to use hydrochloric acid gas some other troubles become apparent. As sulphuric acid possesses many derivatives which approach it in some respects and have comparatively little affinity for water, the most obvious thing was to look among these substances for a suitable esterifying agent. The aromatic sulphonic acids are very stable, can be readily freed from water at moderate temperatures, and have not that destructive power for organic and inorganic materials as oil of vitriol. It was therefore quite logical to try these, and indeed they have proved extremely useful catalysts for the purposes of esterification. The usual way of explaining their action is by assuming that, in the first place, an ester of the sulphonic acid is formed which then reacts with the acetic acid, forming ethyl acetate and the free sulphonic acid. Suppose, for example, we are

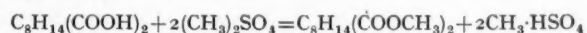
utilising benzene sulphonic acid, then the following reactions take place:—



Reaction No. 2 takes place at 140–150° C. A good plan for carrying it out would be to heat the sulphonic acid in a suitable still and run into it a continuous supply of alcohol and acetic acid at the same rate at which the ester is distilled off. The apparatus could be modified on the lines of the one indicated in Process II, in such a manner as to allow sufficient time for the reaction to take place. A mixture of ester, water, alcohol, together with small quantities of acetic acid and traces of ether, is found in the receiver and has to be separated by the usual methods.  $\beta$ -naphthalene sulphonic acid is more suitable and can be worked at temperatures in the neighbourhood of 125° C.

### Preparation from Other Esters

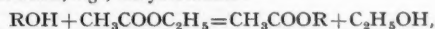
**Method IV.**—There are numerous esters which are not easily prepared in a state of purity by simple means. Some of these can be obtained by transferring the alcohol grouping from some more common ester. Diethyl sulphate, and still more frequently dimethyl sulphate, have been used very widely for this purpose. As a typical example, we give the preparation of the dimethyl ester of camphoric acid. Practically theoretical quantities of material are made use of and the separation is extremely simple. It takes place according to the following equation:—



Two parts by weight of camphoric acid are dissolved in 3.7 parts of caustic potash solution of about 35 per cent. strength. After cooling, 2.75 parts dimethyl sulphate are allowed to flow in and the mixture well stirred. The temperature gradually rises to 60° C. As soon as it begins to fall additional .33 parts caustic potash solution and 1.25 parts dimethyl sulphate are introduced, and the mixture heated to 60° C. till the reaction is complete. The dimethyl camphoric ester which floats on top is separated, washed with dilute soda solution in order to remove the small quantities of acid ester which are formed at the same time, dried and distilled in vacuo, the fraction boiling at 145–147° C., and 20 mm. pressure being collected separately. It is found to consist of the pure dimethyl ester. The reaction in this example, taken from a well-known German patent, is carried out in two stages. The writer has found that it can be modified in such a manner as to form a single operation which works extremely easily and gives superior yields of a very pure ester.

### The Method of Alcoholysis

**Method V.**—There are numerous cases where it would be an advantage to esterify an alcohol by means of some easily available ester, e.g., ethyl acetate:—

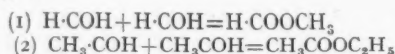


where R is the radical of the given alcohol. This reaction, known as alcoholysis, was first described by Duffy in the *Transactions of the Chemical Society* for 1852. It has been found to have very wide application and apparently is governed by laws similar to those which regulate the hydrolysis of an ester by water. In 1901 Haller observed that acids produced an accelerating effect. Alcoholysis appears to be gaining in interest, if we are to judge from a very recent patent which deals with the continuous transformation of amyl alcohol and ethyl acetate into amyl acetate and ethyl alcohol, an interchange which has been first observed by Friedel and Crafts in 1864, and which at the time apparently was not considered very important. A solution of amyl alcohol in excess of ethyl acetate is mixed with a small quantity of oil of vitriol as a catalyst. The reaction is carried out in a still, the alcohol produced by alcoholysis being distilled off, while the amyl acetate formed is left behind. The process can be made continuous in a manner similar to the one described under Method II, and can be applied in general for the production of high-boiling esters from low-boiling ones. The present-day value of alcoholysis is based on the fact that ethyl acetate can be very easily prepared and therefore affords a convenient means for making esters of high-boiling alcohols.



### Conversion of Aldehydes to Esters

**Method VI.**—It is now 22 years since Tischenko has first described the conversion of lower aldehydes into esters by means of aluminium ethylate  $\text{Al}(\text{OC}_2\text{H}_5)_3$ . Formaldehyde is converted into methyl formate (1) and acetaldehyde into ethyl acetate (2), viz.:

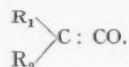


Much study has been devoted to the last reaction. It has been found that a quantitative yield is obtained in 24 hours if 4 per cent. of ethyl aluminate be used and the mixture kept below  $15^\circ\text{C}$ . According to a further patent a convenient method of working is to add gradually 6 parts of aluminium ethylate containing 10 per cent. aluminium chloride to 135 parts acetaldehyde. The mixture is allowed to stand for 10 hours when 123 parts (91 per cent.) of ethyl acetate are obtained.

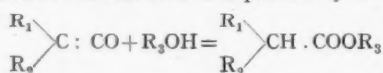
There appears to be a cycle in chemical discoveries. Just as in the case of alcoholysis an invention made 60 years ago only now begins to acquire practical interest, so in the case of the production of ethyl acetate from acetaldehyde the commercial exploitation took a long time to mature. The reason for this was the high cost of acetaldehyde produced from alcohol. Now that acetaldehyde is made very easily from acetylene, this process is bound to become of great consequence.

### Utilisation of Ketenes

**Method VII (1).**—The last example which we described presented a reaction in which a compound was formed from two molecules of another without the elimination of any substance. Such simple reactions are becoming more and more common and will doubtless play a very great part in the future of organic chemistry. We may well admire the ingenuity of a Fischer or Perkin. At the same time, if organic chemistry is going to keep pace with modern life, its synthetic means must be considerably simplified. A class of bodies from which esters can be prepared very easily, and in quantitative yields, are the so-called ketenes, the general formula of which is



Their reaction with alcohols is expressed by the equation:—



At present only two of the ketenes, viz., Ketene  $\text{H}_2\text{C} : \text{CO}$  and carbon suboxide  $\text{C}(\text{CO})_2$  can be obtained by comparatively simple methods. However, pyrogenetic decompositions are likely to furnish a few others, and therefore this simple reaction may prove very serviceable in the future.

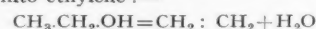
**VII. (2).**—Just as the ketenes their various polymerides can be made to form esters in a similar simple way, only occasionally a little acid being required as a catalyst. However, when dealing with complicated substances one must not forget that a chemical compound is not a scheme of rigid nature, as they are shown in the usual formulae, but rather a mobile system of atoms, which under definite conditions can move very freely. Therefore, in cases of more complex substances all kinds of deviations and changes are possible, which sometimes are occasioned by an absurdly small difference in the conditions. A few years ago, when preparing some new derivatives of camphor, the writer came across a most remarkable instance of the sensitiveness of two substances to such slight changes in a process. If *Cis*-Dicamphocyclobutanedione, which was discovered during that research, is dissolved in a methyl alcoholic solution of caustic potash, and allowed to stand at ordinary temperatures, an excellent yield of the methyl ester of camphocarboxylic acid, a pleasant smelling liquid, is obtained. On the other hand, if ethyl alcoholic potash is employed, the reaction takes quite a different course. No ester is formed, but one carboxyl group is split off and a ketone melting at  $182^\circ\text{C}$ ., which is a heavy odourless white powder, is obtained.

The case which we have described is one of the innumerable exceptions which continue to make chemistry, and particularly organic chemistry, an interesting field for study.

### Catalytic Hydrogenation

**Method VIII.**—The discovery of catalytic hydrogenation by Sabatier and Senderens has led to the investigation of all kind of reactions with a view to simplifying the traditional methods. It was not long before Sabatier and Mailhe found a very simple way of esterifying mixtures of volatile alcohols and acids. The procedure is quite analogous to that of catalytic hydrogenation. A mixture of the vapours of alcohol and acid is passed through a long tube, packed with thoria, alumina or titanium dioxide, heated to about  $300^\circ\text{C}$ . If no catalyst be present, then however much the temperature is varied only a negligible proportion of ester is produced. In working according to this method several important details have to be studied.

(1) Many alcohols can be easily converted into the corresponding ethylene derivatives, e.g., it has been shown by Gregorieff in 1901 that at about  $300^\circ\text{C}$ . alumina will convert ethyl alcohol into ethylene:—



and when alcohol alone is employed, 90 per cent. of the total quantity is converted into ethylene according to this equation.

(2) Each catalyst possesses a definite optimum temperature.

(3) The percentage which is esterified depends on the relative proportions of alcohol and acid. The more alcohol is present for the quantity of acid employed, or inversely, the more acid for a definite quantity of alcohol, the higher is the proportion esterified. Sabatier and Mailhe have found that by using ethyl alcohol and isobutyric acid the following variations in yields were observed:—

Molecular proportion of alcohol to acid.	Percentage yield calculated on acid.
1	71
2	83.5
4	91
10	about 100

The best proportion for practical purposes can only be established on a basis of costs of alcohol and acid, labour, control and time. Sabatier and Mailhe came to the conclusion that titanium dioxide were the best catalysts for the purpose, and that  $280\text{--}300^\circ\text{C}$ . was a most suitable temperature. As the possible number of esters which can be prepared is extremely large, and their component parts may differ very widely in character, it is not surprising that this statement should be contested. So Mailhe and de Godon conclude from numerous experiments that zirconia is as good a catalyst as titanium dioxide, if not better, while Milligan and Reid find that silica gel is a far superior esterification agent than either.

All these statements of comparison must be treated with a certain amount of reserve. Anybody who has worked on, say, catalytic hydrogenation knows how sensitive the catalyst is to slight changes in its raw materials, or course of preparation, and an inventor will frequently be able to achieve with his favourite catalyst better results than somebody else, who perhaps has only made a single experiment with that particular substance. A very careful study of conditions is most important in this method of esterification, for by altering, for example, the temperature, it is quite possible to get unsaturated compounds, or ethers, with disastrous consequences to the main reaction. We have stated that  $280\text{--}300^\circ\text{C}$ . are the best temperatures. However, in cases where one of the components is decomposed at about  $300^\circ\text{C}$ . lower temperatures can also be employed, but the yields are appreciably poorer.

The production of esters in a liquid condition with the assistance of mineral acids has had a very long start, compared with the purely catalytic method, and perhaps taken all round offers certain advantages for the time being, since one can find a plan for making any ester in a liquid medium without an undue amount of research. The utilisation of strong acids has been the great drawback of the classical methods. It is not only the corrosive nature of these acids, with consequent expense in handling, but also the fact that without special costly plant the acid is lost for good. No process has any chance of permanency if it entails a waste of chemicals.

Catalytic esterification has not been able to receive full attention in such a short time. However, its extreme simplicity, freedom from corrosive catalysts and continuous character, are bound to give it the first place wherever it can be conveniently made use of.

## The Dyers' Company and the Colour Industry

### A Talk with the Prime Warden

THE Prime Warden of the Dyers' Company (Mr. J. A. Brewin), when he relinquishes office next month, will be able to look back on a year in which the movement for linking up the Company once more with the colour industry as a whole has made distinct progress. Originally the Company was virtually the guardian of the dyeing industry, taking care, for the good name of the craft, that not only the workmanship but the dyeing materials and everything else involved in the industry were of a satisfactory quality. With the development of the textile industries in the north, the gradual transfer of the dyeing industry to the centres of textile production, the substitution of coal tar dyestuffs for many of the older vegetable, animal, and mineral dyes, and the enormous growth of the synthetic dyestuffs industry, the Company's relation to the trade has gradually changed, and the connection with modern developments has not been as close as it might have been. For some time past there has been a desire to restore something of the old association, and to bring the Company once again into close touch with all branches of the industry. The movement began before Mr. Brewin's election to the Prime Wardenship, but it may truly be said that he has worked hard to foster and develop it, and can look back upon a satisfactory degree of progress. On the personal side the Company has recently recovered many valuable connections. The Liverymen now include Sir Max Muspratt, Sir William Alexander, Dr. Levinstein, Mr. W. J. U. Woolcock, Professor A. G. Green, Professor G. T. Morgan, Sir Joseph Turner, Mr. Sutcliffe Smith, Mr. George Douglas, and others. In other directions the Company is seeking to recover its old interest in all departments of the colour industry.

The Prime Warden, in discussing these matters, indicated that the movement was still in its infancy. "It is very much to be regretted," he said, "that our Company, with its long history and interesting associations, should have lost touch to some extent with the modern dyestuffs industry and its very remarkable developments. There is a decided feeling in favour of restoring our old association with the industry and in that matter progress has certainly been made of late. One evidence of this is the influx of new members, men holding influential positions in the various branches of the chemical, dyestuffs, and textile industries having joined us. It is now recognised that the dye-makers and the dye-users are quite inseparable, and from the national point of view the importance of all sections being linked together is now generally recognised. This Company, has, of course, a very old connection with the industry. It may not be generally known that Sir W. H. Perkin, the discoverer of the first aniline dye, was a Liveryman and Freeman of the City of London and a Friend of this Company. The importance of the colour industry was brought out very clearly during the war, and a very distinguished chemist during his Wardenship was instrumental in bringing the Company in touch with important representatives of various branches of the industry. For a considerable time the City and Guilds have offered a prize in dyeing, and for many years the Dyers' Research Medal has been awarded for the best paper submitted to the Society of Dyers and Colourists on

some original research work in connection with the tinctorial art of dyeing. That medal is regarded as an important award, and has been won from time to time by very distinguished dye chemists. Some of our Liverymen serve on the Board of Trade Dyestuffs Committees (Licensing and Development) and in other ways new and useful connections are being formed.

"I am glad to acknowledge," the Prime Warden added, "the very cordial response made to our desire to re-establish our old connection with all branches of the industry. At this stage it is impossible to indicate any definite programme of work. It is sufficient for the moment to have established closer relations. I think, however, there may be many ways in which the Company may be of use; one is in making use of our Hall as a centre for meetings, etc. The Hall is already the headquarters of the Society of Dyers and Colourists, the Incorporated Association of London Dyers and Cleaners, and the National Federation of Dyers and Cleaners, and it might be made further use of in this direction. The London Section of the Society of Dyers and Colourists hold their meetings here, and carry on certain investigations on the premises. We appreciate the co-operation we are now receiving, and I need hardly say it will be a great gratification to the Company if we can assist the industry in any way possible."

Mr. Brewin, it may be added, is the son of a former Prime Warden, Mr. Arthur Brewin, a very staunch supporter of the Company, who became a Liveryman in 1865, and served as Prime Warden in 1886-7 and again in 1906-7. The present Prime Warden was educated at Rugby, went direct from school into the city, and for 27 years has been a member of the Stock



MR. JULIUS ARTHUR BREWIN

Exchange. He became a Liveryman of the Company by patrimony in 1896, was elected to the Court of Assistants in 1917 and Prime Warden last year. He is one of the Company's representatives on the executive committee of the City and Guilds of London Institute. He is a great believer in the old City Companies, and regards as one of their most important functions the administration, without any cost, of various charitable and educational trusts.

Though the Dyers' Company is one of the oldest of the liveried companies, having obtained its charter in 1471, and still shares with the Vintners' Company the distinction of maintaining a game of swans on the river, the present Hall is comparatively modern. The original Dyers were said to have had a hall as early as 1483 in Anchor Lane. The Hall built later in Thames Street was destroyed in the Great Fire of 1666, and another built on the same site suffered a similar fate. In this way the Company has lost many of its early possessions, but it retains some rare specimens of glass work, a remarkably fine old chest, and other relics of past days. The present Hall, in Dowgate Hill, was built a little over 100 years ago.

It may be interesting to add that the Company's crest contains, on a wreath of the colours, three sprigs of the grain tree, erect vert, fruited gules—that is to say, a plant with green leaves and red berries. The grain tree of heraldry is the *Quercus coccifera* or Kermes Oak, and the word "grain"

was used for the crimson dye obtained in very early times from the "Kermes." "Kermes" was the name given by the Arabs to the oak also known as "Abraham's Oak," which still grows in Palestine and was in olden times cultivated in Britain. The arms of the Dyers' Company were granted probably not later than 1450, and the Mexican cochineal was not discovered until 1518. Owing to the greater cheapness of the cochineal dye the ancient and probably faster dye from the "Kermes" fell into disuse.

Finally, to quote a well-informed authority, no institution connected with dyeing has existed for so many centuries as this "Mystery and Commonalty of Dyers," which is rightly recognised as the venerated mother of all the dye industries in this country. A large proportion of the Liverymen who form the Dyers' Company at the present time consists of eminent scientists in the chemical world and leading men in the dye-making as well as the dye-using industries. These Liverymen have come from Scotland, Manchester, Liverpool, Leeds, Bradford, Huddersfield and Birmingham, and of their own free will joined the Dyers' Company. The Dyers' Company has very much at heart the welfare and goodwill of all chemists, dye-makers and users—diverse entities forming together an

essential unit in commerce and providing indispensable material for defending and safeguarding our existence as a nation.

The affairs of the Dyers' Company have been and still are treated with the utmost privacy, and it looks as if the Company's stately Hall might sooner or later be adopted as a convenient place for meetings of what (for want of a better term) might be called a Privy Council of the Dye Industries in this country. Be this as it may, we see here in London the Dyers' Company—the Mother Company with the modern Dye Industries not altogether unlike the Mother Country with representatives of the younger distant portions of our Empire—and it is obvious that the Company may some day form a central point on which can be focussed (for the ultimate benefit of all) the varied interests of the scientists—the makers and the users of dyes. It is quite possible that H.M. Government in the shape of the Board of Trade have already noted some idea such as this, and it will be interesting to see if the modern dye industries will in time find it advisable to avail themselves of the ancient associations and central accommodation held by the Dyers' Company for practical up-to-date purposes which might become invaluable to the whole nation generally and specially to all connected with the dye industries.

## The Application of Dyes to Textile Fibres

### Mather Lecture by Professor Thorpe

*We give below extracts from the Mather Lecture given by Professor Jocelyn Thorpe, F.R.S., on the above subject at the annual meeting of the Textile Institute at Leicester on Friday, October 19, which we are able to publish by the courtesy of the Institute.*

#### Distinction between Dyeing and Staining

It is doubtful if chemistry enters in any way into the process of dyeing. It is in all probability entirely a physical phenomenon similar, for example, to the adsorption of gas or vapour by charcoal, and although several attempts have been made, no definite solution of this problem has yet been obtained. One point is, however, quite clear, namely—that there is a marked distinction between the mere staining of a fibre and the true dyeing of it. Some of the fibres, notably those of animal origin—wool and silk, for example—possess a marked affinity for certain organic colouring matters provided they are brought together under the right conditions. A basic dyestuff, for example magenta, will be adsorbed by the wool fibre if the wool is steeped in a solution of the hydrochloric of the dye base.

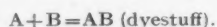
It seems to be evident that the essential property of an efficient stain of this kind is that the salts must be unstable salts which are readily broken down into the base and salt-forming acid. As a matter of fact, it does not require the presence of the fibre or similarly organised substances to cause the dissociation of acid from base, because, apparently, an indifferent material, such as silica, can bring about the same change. This operation constitutes what is known as dyeing, but it would be preferable to alter the name to *staining*, and restrict the term *dyeing* to the much more important operation to be described later. The nitrogenous fibres lend themselves best for the process of staining, and it was not until comparatively recent times that a special class of colouring matters, those belonging to the benzidine series, were discovered (by Böttlinger, in 1896) which could be imparted in the same manner to the non-nitrogenous fibres, of which cotton is the chief member. Moreover, there is now a third class of fibre, the artificial fibre, which is now being manufactured in very large quantities, and which has to be considered in connection with any process of staining or dyeing.

#### Indigo a Typical Dyestuff

The difference between staining and dyeing is a very real difference, because the essential requirement of dyeing, as I understand it, is that the dye should be produced actually in the fibre; or, in other words, that the chemical processes leading to the formation of the colour should take place in the fibre. The operation of true dyeing as distinguished from mere staining can be represented, therefore, by the equations:

- (i.) Fibre + A = fibre A.
- (ii.) Fibre A + B = fibre AB.

Where the equation



There can be no doubt that equation (i.) follows much the same course as the equation already given for the staining operation, and that the nitrogenous fibres lend themselves more readily to

the true dyeing operation than do the non-nitrogenous fibres, but this difference is largely neutralised because the dyeing process is progressive and cumulative, or, in other words, the absence of any original affinity on the part of the fibre for the acceptor A is overcome by repeating the application after the quantity of A first adsorbed has been combined with B, and so on until the required depth of shade has been attained. There can be no doubt that the earliest dyestuffs used by man were true dyestuffs of the kind mentioned above, for although the early history of indigo is lost in antiquity, the knowledge of how it could be brought into solution was certainly known to the Hindus thousands of years before the discovery of India by the Dutch. Indigo is a typically true dyestuff, because A in this case is indigo-white, and B is the oxygen of the air. It was the discovery of how the insoluble indigo could be converted into indigo-white by reduction which established the value of this material, although there can be no question that the discovery was originally made by steeping fabrics in the vat in which the fermentation of the leaves was actually in operation and then exposing them to the oxygen of the air. The subsequent process by which the precipitated indigo was collected and again brought into solution must have been discovered later. This was also the case with another true dyestuff of similar character, which was in use among the ancients, namely, Tyrian purple.

#### Mordant Dyeing and Vat Dyeing

Another dyestuff known to the ancients, and frequently mentioned in the Old Testament as "scarlet," was the dyestuff kermes, a mordant dyestuff, belonging to a group of true colouring matters which, in more recent times, had as its chief representative the mordant dyestuff alizarine, which was extracted from the madder root. The mordant dyestuff is applied to the fibre strictly in accordance with the equation required for a true dyestuff already given, because in this case A is a metallic hydroxide usually of either aluminium, iron, or chromium, and B is the mordant colour. Whereas, in the case of indigo, it is the combination of indigo-white with the oxygen of the air which produces indigo blue on the fibre, an operation which is known as *vat dyeing*, so also the process of *mordant dyeing* is illustrated by the combination of alizarine with aluminium hydroxide to form the finished dye within the fibre. In the middle of the last century the science of organic chemistry had reached a state which enabled chemists to understand the nature of the products with which they were working; they were faced with the fact that there existed two natural dyestuffs, indigo and alizarine, each of which possessed a structure which caused them to be valuable dyestuffs in two totally different ways. It was only natural that they should make every effort to find out the structure of these dyestuffs and to discover the particular molecular com-



plex on which their value depended, with the hope ultimately not only of preparing them in the laboratory and factory, but also of producing other compounds containing the same particular molecular complex but with the remainder of the molecules of such a character as to cause the compounds to possess other shades of colour. Fortunately, the labours of earlier chemists had established a system of constitutional formulæ for organic substances which enabled the chemist to deduce the formula of a natural substance from the fragments formed on breaking it down, and the discovery of the vast wealth of material present in the coal-tar distillate produced a source upon which he could draw in his efforts to reconstruct the molecule, the structure of which he had deduced.

#### The First Synthetic Dyestuff

The first natural dyestuff to yield to this treatment was alizarine, the structure of which was determined in 1868 by Graebe and Liebermann; it was prepared synthetically in the following year by these chemists in Germany, and simultaneously by W. H. Perkin, in England. The determination of the structure of alizarine revealed the particular molecular complex—namely, the association of an hydroxyl group with a carbonyl group, on which the property of mordant dyeing depended, and since then the labours of the colour chemist have led to the production of a vast number of other colours of similar character and fastness.

The elucidation of the structure of indigo was more troublesome, and it was not until after Baeyer had worked for 18 years (1865–1883) on the problem that he was able to state its structural formula with certainty. Nevertheless, several methods of synthesis soon followed, and the production of artificial indigo on the factory scale was quickly an accomplished fact. Here, again, the discovery of the structure of indigo revealed the principle on which vat dyeing depended, and showed that the presence of a double bond associated with a carbonyl group was essential in order to confer this valuable property on the compound. Probably no discovery has had a greater effect on commercial production than this.

#### The Indanthrene Dyes

It is, however, in the production of a totally new chemical class of colouring matter that the discovery of the principle underlying vat dyeing finds its most important application, for in 1901 Bohn discovered indanthrene by fusing  $\beta$ -amino-anthraquinone with caustic alkali. There can be no doubt that the discovery of this substance was quite accidental. Its production could not have been foreseen; indeed, for some time after its discovery its structure remained unsolved, and it was not until 1907 that Scholl completely settled this point. Flavanthrene (indanthrene yellow) was discovered at the same time, and its constitution was also established by Scholl. No one who has prepared both indigo and indanthrene can have failed to notice the close resemblance the one bears to the other. The blue colour and marked copper reflex are characteristic of each, indeed, although there is no recorded statement to support it, one cannot help thinking that Bohn must have thought in the first instance that by some strange chemical freak he had synthesised indigo. He would, of course, at once have discovered his mistake when he attempted to prepare the vat from the new compound by means of hydrosulphite, because it is characteristic of the indanthrenes vats that, unlike indigo and its analogues and homologues, the vat produced is always intensely coloured, but he would notice the fact that the insoluble blue pigment passed into solution in the vat, and the discovery that he was dealing with a new class of vat dye would necessarily follow. The elucidation of the structures of indanthrene and flavanthrene revealed the fact that their vat dyeing properties depended on the presence of the same molecular complex as indigo, and at once opened out an enormous field for investigation. This has been followed up in recent years with such success that the number of colouring matters of this class is very large. Practically all shades are represented, and for brilliance of colour and fastness to light and other conditions they are unsurpassed by any other group of dyes. They belong to the most stable organic compounds known. Indanthrene, for example, can be heated to 470° in air, to 400° with concentrated hydrochloric acid, and to 300° with potassium hydroxide without undergoing change.

## The Investigation of TNT in the War.

### A Paper by the Government Chemist

ON Tuesday the Government Chemist (Sir Robert Robertson) read a paper on "The Chemistry of Trinitrotoluene" before the Chemical Association of the Northern Polytechnic Institute at Holloway, London.

Before the war, he said, very little TNT was made in this country, and that by an old-fashioned method. The immediate problem, therefore, before the investigators at Woolwich when the war started, was to find the best method of preparing this compound economically. A method was first worked out in the laboratory, and then applied, with success, on the semi-manufacturing scale, working with a quarter of a ton of raw material at a time. The chief feature of the process, which consisted in the further nitration of mono-nitrotoluene, was that it was found advantageous to keep the process in operation at a temperature of 70° C. for two hours, and then to complete the nitration at 100° C. This method was added to on the manufacturing scale.

The product was purified in boiling water and what resulted was crude TNT, which contained a proportion of DNT and isomerides of TNT other than the symmetrical 2:4:6 form which was required. The crude TNT was purified by washing or crystallising from alcohol, and, later in the war, by the sulphite method in which sodium sulphite was used to form a sulphonate which was more readily dealt with. The process of detoluation of the waste acids had to be carried out because TNT dissolved to quite a considerable extent in the nitrating acids, rendering ordinary processes for the recovery of these unsafe. Detoluation was carried out by adding the raw material, mono-nitrotoluene, to the waste acids, when the nitro bodies could then be extracted in a harmless form.

### Co-operation of Physical and Organic Chemists

The co-operation of the physical chemists was called in to discover the exact proportion of the various possible isomerides which was actually present in the purified TNT product. By means of a laboriously constructed ternary diagram, work on which was carried out by Dr. Gibson, a series of curves was obtained by means of which it was possible to obtain an exact knowledge of the purity of a sample of TNT from a determination of its setting point. It was very desirable to have this knowledge as impure samples of TNT tended to liquefy and run out of their containers. In addition to this work organic chemists prepared samples of all the six possible isomerides and investigated their properties, although these did not all occur in the manufactured TNT. As an example of the effects of using an insufficiently purified TNT, Sir Robert referred to a case which arose in connection with amatol, the mixture of TNT with ammonium nitrate, some samples of which developed frothing and became useless. This was found to be due to a trace of pyridene which completely decomposed the molecule of gamma-TNT, one of the isomerides in which the nitro groups are in the ortho position relative to one another.

A most ingenious form of bomb calorimeter was devised in order to investigate the heat of formation of TNT and its explosive pressure. As this latter was of the order of 300 tons per square inch and was developed in about one-hundred-thousandth part of a second, its construction and successful operation was a remarkable achievement. A special burette was also constructed for use in connection with this bomb to determine the nature of the gases involved. Slides were shown of these pieces of apparatus. As a result of the determination of the heats of formation, it was shown that the common symmetrical TNT actually had a lower explosive power than some of its isomerides, and actually 5 per cent. of energy would have been saved had it been practicable to produce one of these. The question of stability, however, made the normal product preferable.

As a result of this work, some 3,000 to 4,000 tons of TNT per week were finally produced in the various factories in the kingdom, and more was known of the chemistry of trinitrotoluene than probably any other organic compound.

A discussion followed the lecture, and among those who contributed to it was Mr. F. M. Potter, who emphasised the economy which had been obtained in the manufacture of TNT as a result of the work carried out at Woolwich.

# The Chemistry of the Sesquiterpene Group—(I)

By Cecil Hollins, B.Sc., A.I.C.

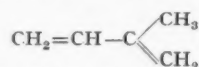
*This is the first of two articles in which Mr. Hollins summarises our knowledge of the sesquiterpene series, interest in which has been revived by the recently published accounts of Ruzicka's brilliant researches. As will be seen, these compounds are not without their technical interest.*

AMONGST the innumerable products synthesised by plants one of the most interesting groups is that which includes the hydrocarbons  $[C_5H_8]_n$  and their derivatives. These are known as the Terpene Family and are met with in the essential oils distilled from various parts of plants and trees. The hydrocarbons are conveniently divided into

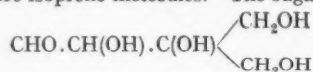
Hemiterpenes	$C_5H_8$
Terpenes proper	$C_{10}H_{16}$
Sesquiterpenes	$C_{15}H_{24}$
Diterpenes	$C_{20}H_{32}$

and Polyterpenes with still larger molecules.

The simple hemiterpenes are not found in nature, though *isoprene*,



is commonly produced in the destructive distillation of members of the higher groups. It will be seen later that this compound is the fundamental hydrocarbon of the whole family and that every terpene structure is probably built up by the coalescence of two or more isoprene molecules. The sugar apiose,



which occurs in certain plants, is possibly a forerunner of isoprene and the terpenes generally.

The terpenes proper and their derivatives are a very numerous group and include such substances as myrcene, geraniol, limonene, pinene, terpineol, borneol and camphor.

Amongst the few naturally occurring diterpene compounds may be mentioned  $\alpha$ - and  $\beta$ -camphorenes, cryptomerenes and abietic acid. Caoutchouc and many complex resins seem to belong to the polyterpene class.

The investigation of sesquiterpenes and their derivatives falls naturally into three periods.

In the early days—prior to about 1900—very little was known beyond the mere occurrence of certain sesquiterpenes in particular essential oils. Wallach, to whose monumental researches we owe a very large proportion of our knowledge of the  $C_{10}$  group, suggested that just as terpenes were hydrogenated benzene compounds so sesquiterpenes would probably be found to be hydrogenated compounds of the naphthalene series.

In the second period the outstanding name is that of Semmler, whose careful investigations and especially his application to sesquiterpenes of Willstätter's method of reduction (with hydrogen in the presence of colloidal platinum) enabled him to classify the sesquiterpenes into aliphatic, mono-, bi- and tri-cyclic groups and to obtain considerable insight into their constitution.

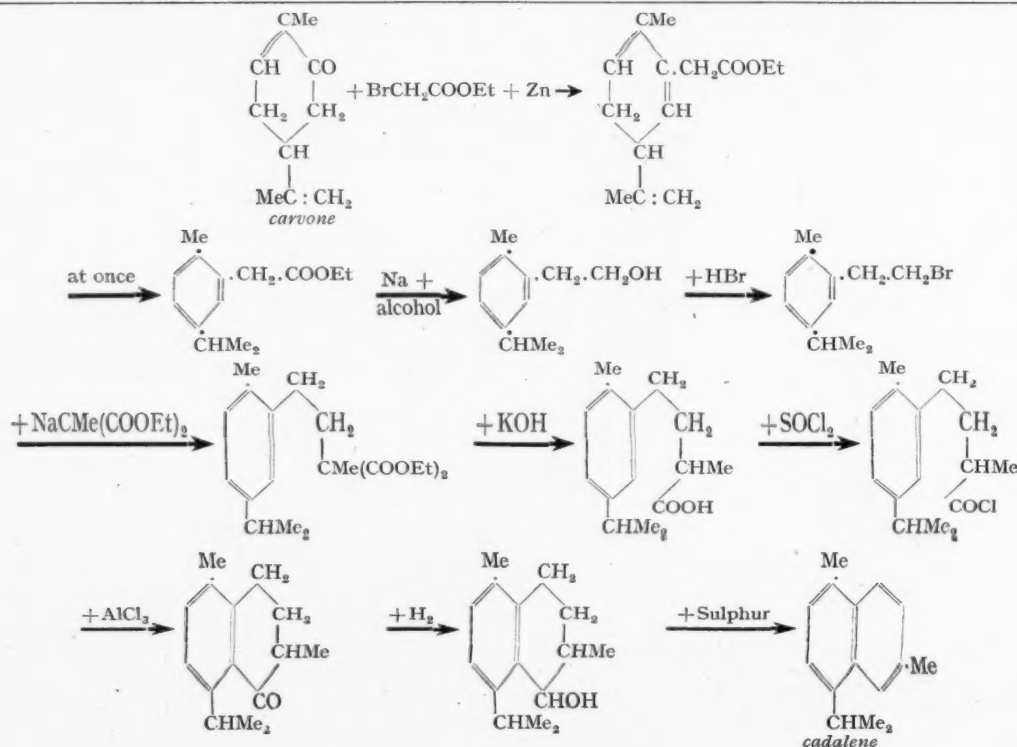
The latest advances in this field have been made since 1918 by Ruzicka, to whom is due the first definite proof of the relationship of many sesquiterpenes to naphthalene, and who has recently achieved the first synthesis of naturally occurring sesquiterpene compounds (farnesol and nerolidol).

Sesquiterpene derivatives are not without their uses in commerce, though as a rule the perfumer finds it an advantage to remove them from his essential oils. Farnesol and nerolidol, however, are employed as "fixatives" and as such form the basis of various perfumes. Santalol has long been applied in pharmacy and numerous patents have been taken out for the preparation of tasteless derivatives from it.

## Methods of Investigation

Before reviewing in detail the state of our knowledge of the sesquiterpene group it will be useful to indicate the general methods by which the difficult problem of structure has been attacked.

It is first necessary to determine the elementary composition and for this purpose the substance must be obtained free from all impurities. Hydrocarbons are fractionally distilled in



*tacuo* and all oxygenated compounds removed by treatment with sodium before the final fractionation. Primary and secondary alcohols may be purified by conversion into their acid phthalates by means of phthalic anhydride. These are solids which form crystallisable salts. Paolini, by recrystallisation of the strychnine salts until there was no further change in optical activity, obtained after hydrolysis very pure samples of linalool, santalol and other alcohols. Tertiary alcohols offer more difficulty. They are not esterified by the usual methods and under the mildest treatment they frequently lose water and give hydrocarbons. They may usually, however, be purified by Weinhaus's method—conversion into crystalline chromates by shaking with chromium trioxide in well-cooled petroleum ether. For the separation of a mixture of sesquiterpene alcohol and hydrocarbon the alcohol may be converted into its sodium or potassium derivative and the hydrocarbon distilled off; the alcohol is then liberated by addition of water, extracted, dried and distilled. Alternatively, the alcohol may be treated with potassium and then with  $\text{CS}_2$  to form the xanthogenate,  $\text{C}_{15}\text{H}_{28}\text{O}\cdot\text{CS}\cdot\text{SK}$ , from which the alcohol is liberated by superheated steam.

Ketones and aldehydes are isolated and purified by means of their semicarbazones.

All fractions are followed by determinations of boiling point, specific gravity, refractive index and optical rotation. These data are a good guide to the nature of the compound under investigation. Terpenes boil at 150–180° at ordinary pressure; sesquiterpenes about 100 degrees higher or 120–150° at 10–15 mm. pressure. The density of terpenes ranges from 0.80 to 0.86, while for sesquiterpenes the range is 0.87 to 0.94. Semmler found that a density of 0.91–0.92 indicated a sesquiterpene of the naphthalene type, the terpinolene type having a density of about 0.93.

The number of double bonds present in the molecule is clearly shown by the "molecular refraction" calculated from the formula of Lorenz and Lorentz—

$$M.R. = \frac{n^2 - 1}{n^2 + 3} \times \frac{M}{D}$$

where  $n$ =refr. index,  $D$  the density and  $M$  the molecular weight. As the molecular refraction is an additive property of the atoms and groupings in the molecule, the presence and number of double bonds in a substance are indicated by increments in the value for this quantity. Thus for compounds of the empirical formula  $C_{11}H_{12}$ , one ethylene linkage produces a molecular refraction of 64.4; two give the value 66.1, three 67.8 and four 69.5. Conjugation of two or more double bonds reveals itself in a further exaltation of the molecular refraction.

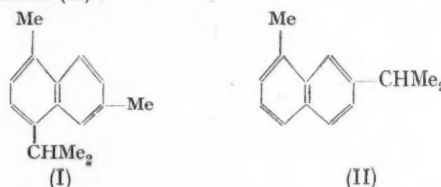
The final confirmation of the number of double bonds is obtained by reduction in the cold (usually in dry ether) with hydrogen in the presence of colloidal platinum (Willstätter's method) or colloidal palladium (Paal's method). Two atoms of hydrogen are absorbed per molecule of substance for each double bond present. The formation of additive products with bromine, halogen acids, nitrosyl chloride or nitrous gases is much less reliable as an indication of the number of double bonds.

If conjugated ethylene linkages are suspected the substance is treated with sodium and alcohol, by means of which two atoms of hydrogen are introduced for each pair of conjugated double bonds. Thus farnesene—

$\text{Me}_2\text{C} : \text{CH} \cdot \text{CH}_2 \cdot \text{CH}_2 \cdot \text{CMe} : \text{CH} \cdot \text{CH}_2 \cdot \text{CH} : \text{CMe} \cdot \text{CH} : \text{CH}_2$   
is reduced by sodium and alcohol to dihydrofarnesene, in which two hydrogen atoms have been added in the 1:4-position:

Reduction by Willstätter's method, on the other hand, gives octahydrofarnesene,  $C_{15}H_{32}$ , a completely saturated paraffin hydrocarbon.

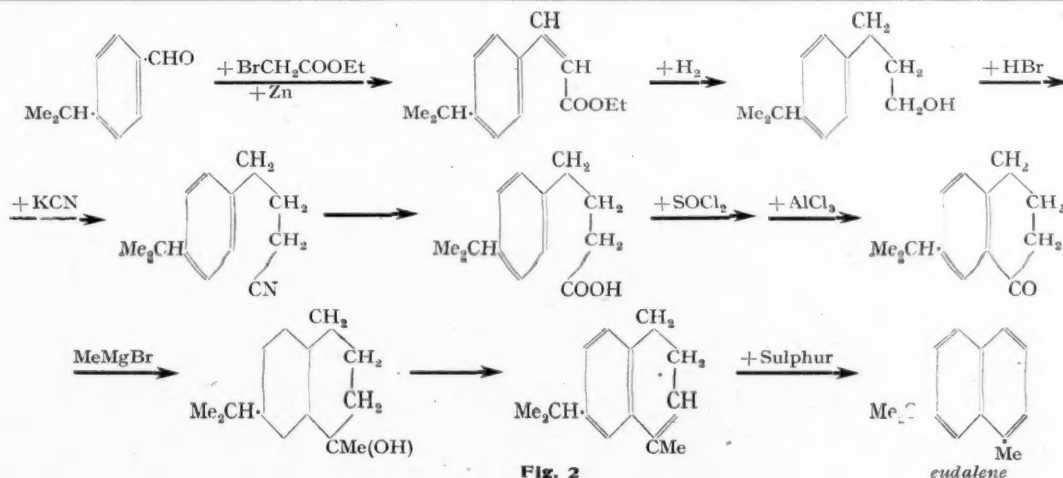
The facility with which the  $C_{10}$  terpenes undergo isomerisation is even more marked in the  $C_{11}$  series and the difficulties in determining constitution are thus considerably increased. It is exceptional to be able to regenerate a sesquiterpene unchanged from any of its derivatives. Oxidative methods are only rarely of much assistance in the determination of structure, for even ozonisation frequently fails to give definite products. Ruzicka's introduction\* of sulphurisation as a method of dehydrogenation was therefore a very considerable advance, for experiments showed that the carbon skeleton was unaffected except that a tertiary methyl group might be eliminated in the form of  $CH_3 \cdot SH$ . The method consists in boiling the sesquiterpene with the theoretical amount of sulphur until no sulphur crystallises out from a cooled sample. The product is a naphthalene hydrocarbon, which may be separated and identified by conversion into its picrate. So far, two such naphthalene hydrocarbons have been prepared—*cadalene* (I) is obtained from cadinene, calamene, copaene, farnesol, zingiberene and the bicyclic alcohol occurring in Java citronella oil. Eudesmol, santalene and selinenes on the other hand give *eudalene* (II) :



The formation of naphthalene derivatives is no evidence for the pre-existence of the double ring in a sesquiterpene, for zingiberene is monocyclic. Cyclisation obviously occurs during the reaction. The recent work of Thorpe and Ingold on annular tautomerism has shown, however, that the relation between a ring-compound and the corresponding unsaturated chain compound may be much closer than has hitherto been imagined. Certainly in the sesquiterpene series cyclisation is of frequent occurrence, though the reverse change does not seem to have been observed.

Alcohols give by sulphur treatment the same product as the corresponding sesquiterpenes obtained from them by dehydra-

\* The method had previously been applied by Vesterberg to abietic acid.



**Fig. 2**

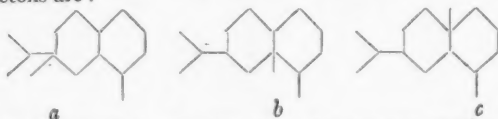


tion. An interesting observation of Ruzicka's is that all the  $C_{15}$  compounds from different parts of the same plant yield on sulphurisation the same naphthalene hydrocarbon.

The constitutions of the two fundamental naphthalene derivatives so far obtained from sesquiterpenes have been determined by Ruzicka and confirmed by synthesis. Cadalene (Ruzicka and Seidel, *Helv. Chim. Acta*, 1922, 5, 369) is 1:6-dimethyl-4-isopropynaphthalene (I) and has been synthesised from carvone by the method shown in Fig. 1.

For the synthesis of eudalene, which is 1-methyl-7-isopropynaphthalene, a similar series of reactions starting from cuminaldehyde was successful (Ruzicka and Stoll, *ibid.*, 923), Fig. 2.

The position of the methyl group which is lost from the  $C_{15}$  skeleton during sulphurisation is determined from the following considerations. Only a tertiary methyl group is likely to be eliminated in this way, hence the possible  $C_{15}$  skeletons are:

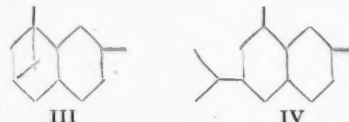


Of these, *a* is ruled out, since it would give two products on sulphurisation—one by elimination of the methyl group, the other by elimination of the similarly situated isopropyl group; none of the second product is formed. Of the remaining alternatives only *c* is capable of being constructed from three isoprene molecules—

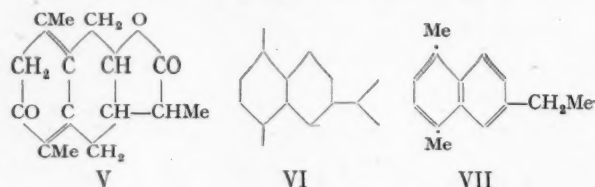


Hence Ruzicka concludes that *c* represents the  $C_{15}$  skeleton of the sesquiterpenes of the eudesmol type.

These two types most probably do not include all the  $C_{15}$  skeletons occurring in natural sesquiterpene compounds. The structures suggested by Semmler and Mayer (1911) for  $\beta$ - and  $\gamma$ -caryophyllenes are derived from a skeleton (III), or, if the bridge linkage be broken, from (IV):



In santonin (V) one of the methyls of the  $\cdot CHMe_2$  group has become oxidised to  $\cdot COOH$ . The fundamental hydrocarbon is thus 1:4-dimethyl-6-isopropynaphthalene (VI), while the product of sulphurisation would probably be (VII):



1:4-Dimethyl-6-ethylnaphthalene (VII) has actually been obtained from santonin by the action of hydriodic acid, but no sulphurisation experiments have yet been described.

## The British Artificial Silk Industry

By P. E. King

Mr. P. E. King, in a paper before the autumn conference of the Textile Institute at Leicester, on Friday, October 19, dealt comprehensively with the artificial silk industry. The substance of the paper is given below.

### Varieties and Manufacture of Artificial Silks

FROM a commercial standpoint artificial silks only date from the last 25 years. There are, at the present time, four distinct types of artificial silk, that is distinct, in that they are manufactured by different methods. In the order of their introduction on the market they are:—1. Chardonnet or Nitro silk, also called Tubize silk. 2. Cuprammonium. 3. Viscose. 4. Acetate silk.

**Chardonnet silk** is manufactured from cotton, usually cotton linters. This, after purification, is converted, by the action of sulphuric and nitric acids, into a nitro-cellulose, the process being similar to that of the manufacture of gun-cotton, except that the degree of nitration is less. After a thorough washing, the wet nitro-cotton is dissolved in a mixture of alcohol and ether to form a viscose solution. This solution, after filtration, forms the spinning liquid. The next operation, that of spinning, consists of forcing the viscous fluid through fine openings in glass tubes. On emerging, the thin streams are coagulated by evaporation of the solvents, and filaments of silk are produced. A number of these are caught up to form a thread, and are wound on to a running bobbin.

The spinning apparatus is enclosed in a cover, and a current of warm, damp air passing through carries the vapours of alcohol and ether away, to be condensed in a suitable manner. By distillation a great part of the mixed solvents is recovered. The recovery of expensive solvents, as completely as possible, is naturally very desirable. Although at this stage the threads when dry are lustrous, they are too inflammable to be of use, and the silk also keeps badly and dyes with difficulty. It is still chemically in the form of nitro-cellulose, and in the next process, called de-nitration, the nitro groups are removed and regenerated cellulose, or cotton, results. The removal is accomplished by a solution of ammonium sulphate, and the threads, after the treatment, are still lustrous but somewhat weaker. After bleaching, the commercial thread is obtained. It will be observed that the ultimate or final thread consists of

regenerated cellulose or cotton, but in a different physical form. This point is important when the dyeing of artificial silks is undertaken.

**Cuprammonium silk**, also termed Cuprate or Pauly, was produced in the first place largely by the Germans at Elberfeld. Cotton has been, and still is, the chief raw material for this silk, but I believe wood-pulp can also be employed. Whichever raw material is used, its subsequent treatment is entirely different from that for chardonnet silk. After purification, then preferably mercerisation, the cotton is stirred up with a solution of copper in ammonia until solution is complete. The solution of the copper is performed by passing air through a solution of ammonia, kept at a low temperature and containing copper turnings. This solution is dark blue in colour, and after solution of the cellulose a blue viscous solution is obtained which, when filtered, forms the spinning fluid. This is forced through glass jets into a coagulating or setting bath. The coagulating bath may differ in composition but most usually is one of strong caustic soda, also containing glucose. The fine filaments are drawn off under tension and caught up to form threads which are wound on to bobbins. Further purification consists in the removal of the copper and in bleaching, when the commercial thread is obtained. For commercial success the subsequent recovery of the copper and ammonia is of importance.

This variety of silk is also being produced in fine filament form, which is as fine as, or even finer than, real silk. Thiele first made this at Yarmouth by drawing out a thick filament to a much finer one before coagulation had fully set in. This was not a commercial success, but it is now being made on the Continent and marketed as "Eagle" and "Bemberg" silk. It is generally less lustrous than the coarser qualities of artificial silk, but otherwise its appearance and handle resembles the real article. This silk is also a regenerated cellulose and thus will dye like mercerised cotton.

Turning our attention to the third variety and at the same

time the one most largely manufactured—namely, *Viscose*—we find that another different chemical process is responsible for its production, which was entirely British in origin, and there can be little doubt that its successful development has been mainly due to the research carried out in this country.

The raw material is wood-pulp, used in the form of sheets, called bleached sulphite wood-pulp. This is taken and submitted to what one may term a mercerising action—that is, it is steeped in caustic soda solution of 17-18 per cent. strength. After squeezing out the excess of alkali, the alkali-cellulose is ground into a crumb-like mass in a mill. The mass, termed crumbs, was originally matured by storing in boxes, but later reseraches realised the importance of oxygen to this maturing process. The oxygen, originally obtained from the air, can be more quickly brought into play by the addition of sodium peroxide to the caustic soda, and even this action can be much accelerated by the further addition of certain catalysts such as some compounds of iron or copper. The amount of oxygen absorbed is only very small, but its effect physically is very great. By its use the process can be shortened and solution of cellulose obtained of varying viscosities from which silks of different qualities can be produced.

The next operation is the production of what is termed "cellulose xanthate" by the action of carbon bisulphide on the matured alkali-cellulose. By this reaction is formed a brown gelatinous mass which is dissolved in dilute caustic soda. It is this solution which, after proper ageing, forms the spinning solution. The ageing has for its object the formation of a liquid which, on spinning, gives the best results, and during the process the mass of viscose loses carbon-bisulphide and becomes proportionately greater in cellulose. An alteration also occurs in the viscosity. The solution, after filtration and removal of air bubbles, is forced through perforated jets, either of platinum or some other metal. The spinning bath in which coagulation takes place usually consists of sulphuric acid, ammonium sulphate and glucose, but other baths may be used. The actual spinning is most usually carried out in a Topham centrifugal box. The thread, after leaving the coagulating bath, passes over a roller, through a vertical reciprocating tube into a circular box, rapidly rotating on a vertical spindle. The centrifugal force throws the thread to the side of the box, where it builds up into an annular cake. A certain twist is also imparted to the thread by the rotation of the box. When the box is full the cake is removed and wound into skeins. Crude viscose silk is thus obtained. Subsequent purification is carried out by removing the sulphur in a bath of sodium sulphide, washing and bleaching. Once more it is interesting to observe that the final product is a regenerated cellulose, all the sulphur and soda being eliminated.

The method just described is one method for viscose silk production, but numerous others have been patented, especially in connection with the alkali treatment, but I cannot say whether they are used on the large scale.

Later research on viscose production has been that of Bronnert, who has succeeded in obtaining extremely fine filaments. Using the same spinning aperture as for the usual viscose filament, by altering the strength of the acid spinning bath various sizes of filaments can be obtained, even as fine as  $\frac{1}{4}$  denier. The size of real silk is  $1\frac{1}{2}$  denier. Whether this process is being utilised on a large scale I cannot say.

*Acetate silk*, now termed "*Celanese*," is the most recent of artificial silks, and after many vicissitudes is making headway. Acetate silk differs from the other three varieties in this important respect: the silk as marketed is not regenerated cellulose or the original raw material in another physical form, but cotton or cellulose containing the acetic acid groups in combination with it, or, to put it in another way, is the same chemically as that dissolved in the solvent for spinning. Cotton is usually the raw material used. This, when purified, is converted into a compound containing acetic acid, or what is termed chemically an acetyl compound of cellulose. This may be compared with the similar nitro-cellulose, except that acetic acid replaces the nitric acid. This derivative is dissolved in acetone and the solution filtered. The viscous solution is then forced through fine openings in a metal cap, the issuing filaments are coagulated by a current of warm air, and the solvent recovered as far as possible. The filaments are then brought together to form the desired count of thread

and the requisite twist given to it. The composition of this silk corresponds chemically to approximately the di-acetyl derivative.

#### Identification. Properties and Dyeing of Artificial Silks

*Chardonnet silk* is easily distinguished by the blue colour obtained when it is treated with concentrated sulphuric acid, in which is dissolved a crystal of diphenylamine. If already dyed the colour must first be removed. The distinction between *Viscose* and *Cuprammonium* silks is not easily carried out, but, if undyed, a treatment with concentrated sulphuric acid differentiates between the two varieties. *Viscose* becomes considerably more reddish brown, cuprammonium going more straw-coloured. The method of taking cross sections is also useful, and helps to distinguish certain varieties. *Acetate silk* is the most easy to identify. On ignition it melts and drops off into beads of carbon, similar to sealing-wax.

All varieties of artificial silk are more lustrous than real silk, viscose being particularly so, and celanese being of a more subdued lustre. Celanese is a non-conductor of electricity and also of heat; it feels warmer than the other varieties. In handle, comparing counts of equal denier per filament, celanese is somewhat softer. There is a great difference between the three hydrated silks—chardonnet, viscose and cuprammonium on the one hand, and acetate silk on the other, when submitted to the action of water, chemical agents, and dyestuffs. The first three are easily wetted with water, but the latter not so readily. Boiling water has little effect on nitro-cuprammonium or viscose silks, but the greater part of the lustre of acetate silk is lost: this silk also shrinks and becomes soft and woolly in character. This behaviour also occurs, to an extent depending on the time treated, at temperatures below  $100^{\circ}\text{C}$ ., but it is stated that the later manufactured celanese will stand  $85-90^{\circ}\text{C}$ . without injury. Treatment with boiling 1 per cent. caustic soda shows great differences between the various types. Chardonnet, cuprammonium and viscose are not greatly affected; viscose stands a kier treatment with 2° Tw. caustic soda; acetate silk is saponified, shrinks and loses lustre and weight.

The dyeing of artificial silk is at the present time the subject of much research, especially the dyeing of acetate or celanese silk. The three hydrated silks dye on the whole like mercerised cotton—that is, they can be dyed directly with the direct cotton colours, vat and sulphur colours. Chardonnet, moreover, owing to residual traces of sulphur or sulphur compounds, will dye directly with basic colours, without preliminary mordanting, and viscose silk also, to some extent, exhibits this property. Celanese silk, however, owing to its still containing the acetic groups, will not dye directly with direct cotton, sulphur, and vat colours. If a part of the acetic acid is removed by a treatment with caustic soda, a process called saponification, dyeing with these colours takes place, but this method, owing to difficulties encountered, is, I understand, very little used at present. There are, however, certain dyestuffs which can be used for acetate silk, those of the basic group, and some acid colours of weak acidity. The basic dyestuffs owe their power of attraction to the acid groups contained in the silk—it is, in fact, somewhat similar to the dyeing of tanned cotton with the same class of colours.

Other methods for dyeing acetate silk are the absorption of certain organic substances and subsequent formation of colour by diazotisation and development; also the use of ionamines, which, although they can be used directly, giving dyed shades, are generally better developed. Much research is going on in this connection, and the tendency is to find dyestuffs which give the desired shade by a direct dyeing.

#### Commercial Production, Uses, and General Remarks

The production of artificial silks is now on a very large scale. Contrary to what was once expected, chardonnet silk is still being manufactured in France and in America. Cuprammonium silk is also made in Germany, but on the Continent the tendency is for viscose to supplant cuprammonium, and plants operating on the latter are being converted to viscose. Viscose forms the largest proportion of the total production of artificial silks, and is being made in ever-increasing quantities in this country, and especially in America. It is also produced in France, Germany, Italy, and other countries. Acetate silk or celanese is, as you are aware, manufactured in this country, and I believe also in America, and is making headway. A glance

at the table below will show you the estimated production of artificial silks in the year 1922, compiled by Mr. S. A. Savage, of the American Viscose Co. This is the company of which the greater part of the shares are held by Messrs. Courtaulds, Ltd.

ESTIMATE OF THE WORLD'S ANNUAL PRODUCTION OF ARTIFICIAL SILK, DECEMBER 31, 1922.

	Lbs.
United States .....	23,500,000
England.....	15,340,000
Germany .....	12,584,000
Belgium .....	6,292,000
France .....	6,292,000
Holland .....	2,516,000
Austria .....	1,573,000
Switzerland .....	1,887,000
Hungary .....	1,887,600
Poland .....	943,800
Italy.....	6,292,000
Czecho-Slovakia .....	629,200

Total ..... 79,738,000

The world's production of real silk is given as 59,000,000 lb approximately, hence artificial silk is being used in much greater quantity than real silk. Mr. Savage also states that for this year the production will be (for America alone) about 7½ million pounds more.

Statements made by the American Silk Association and also by two of its members will be of interest. The Association notes that the stupendous growth of the artificial silk industry is without parallel among the textile industries of the world. There is a growing belief that artificial substitutes for silk will ultimately replace the natural fibre, a large part of the material which goes into ordinary wear; that the growers and reellers of the natural fibre are building up a class of very dangerous competitors, and that, unless this fact is recognised and the warning accepted, it may yet develop that fabrics made of artificial silk will make for themselves a place in the market from which no profit-bearing competition can dislodge them. The artificial product for embroidery purposes has been exploited extensively and with a great deal of success, and if this branch of the business is to come back to the real silk manufacturers something will have to be done to offset the competition of the artificial silk manufacturers in this line.

The continued growth of the artificial silk industry is reflected in the plans for expansion of a number of large companies. The American Viscose Co., already the largest producers of artificial silk in the United States, are planning the erection of a five million dollar plant in Philadelphia. This company has already large plants elsewhere in Pennsylvania and in Virginia. The plant at Marcus Hook, Pennsylvania, is the largest in the world. The Du Pont Fibre Co., with an enormous plant near Buffalo, recently increased its capital from 12 to 15 million dollars in order to provide for two additional plants for the production of fibre silk. One of them will be at Nashville, Penn., the other will be at New Jersey. Courtaulds, Ltd., are soon to erect a large plant in Canada. It is said that the plant will cost approximately 2,000,000 dollars and will give employment to 1,500 hands. These statements will show you the enormous extent to which the industry has advanced.

Coming to the uses of artificial silk, it would be impossible in the short time available to enumerate and discuss the many types of fabrics into which it enters, either alone or with other fibres. The greatest proportion is no doubt used on knitting machinery of some kind or another, and it is probably through this machinery that the great increase is due. It has been stated that hosiery, knitted goods, ties and braids consume about 50 per cent. of the output in the United Kingdom; woven cloths between 10 to 20 per cent., yarns twisted with wool about 5 per cent., and elastic webbing between 5 to 7 per cent.

You will have observed from the various exhibits that there is no wearing apparel for ladies' wear, except boots and shoes, into which artificial silk cannot enter. It is used in increasing quantities for twisting and plaiting with cotton, real silk, and wool for hosiery purposes, and is on the increase for use in garments for underwear. Large amounts are used for hand-knitting, and the lace industry consumes considerable amounts of artificial silk. It is used as warp and weft in ladies' dress materials and for upholstery purposes. Staple fibre consists of artificial silk, but is made by cutting the silk

into short lengths, carding and preparing the yarn in a similar manner to cotton. This is also used for mixing with wool. In conclusion, one perhaps is justified in feeling proud of this country, in that it has been the foremost in the development and use of artificial silks.

## Seized Dyes and British Labour

To the Editor of THE CHEMICAL AGE.

SIR,—One result of the policy of M. Poincaré in the Ruhr is the serious effect it is having on the British dye trade—a result which, as the following facts prove, ought to receive the attention of the British voter. A firm of French dyers has taken an office in Bradford from which grey piece goods are sent to France and, despite the cost of carriage to and from the Continent, returned to this country dyed for anything between threepence and sixpence a yard cheaper than the work can be done in England.

These are the facts, and it has to be admitted that the achievement might have fairly serious consequences for our dyers and finishers in Lancashire as well as Yorkshire. This cannot be said to be due to the rumour that France is under-selling us in our own markets because her dyers and finishers work a longer day for less money than ours do. That unctuous pretext for reducing wages and extending hours in this country is no explanation whatever of this economic phenomenon at Bradford.

The truth is that for months past France has been "seizing" all the German dyestuffs she could lay her hands on. Thanks to the strides that have been made in the range and quality of British dyestuffs, the ensuing failure to deliver reparation dyes has caused no crisis among dye-users. But seized dyes are obviously cheap dyes, and it certainly does not seem just that France should use these to under-sell us in our home markets and so prejudice the wages and the hours of British working folk.—Yours, etc.,

JAMES SEXTON

Birks House, Gatacre, Liverpool. (M.P. for St. Helens).  
October 22, 1923.

## Yorkshire Natural Science Association

Dr. S. F. Dufton on the Work of Priestley

EIGHTEEN new members and sixteen resignations, representing a net advance from 164 to 166 in membership, were reported to the sixth annual meeting of the Yorkshire Natural Science Association, held in the Philosophical Hall, Leeds, on Saturday, October 20, under the chairmanship of Dr. Harold Wager, Chairman of the Council. The report was adopted, and the following officers were elected or re-elected:—President, Dr. S. F. Dufton; vice-president, Mr. P. J. Vinter; hon. treasurer, Miss L. I. Scott; hon. secretary, Mr. E. G. Laws; members of the Council, Miss F. Burdett, Mr. Greevz Fysher, Mr. A. Jackson, Mr. A. W. Mason, Major W. Newbold, and Dr. Terry Thomas. It was decided to invite Professor A. Smithells, on his resignation, to become an honorary member.

The new president gave an interesting address on the scientific and educational work of Joseph Priestley, of whose achievements, he said, he hoped full and warm-hearted recollection would be maintained in Leeds by periodical recital, for it was in Leeds that Priestley's real scientific research began. Reviewing Priestley's painstaking research into the problem of why the air does not become permanently vitiated by all the fires and putrefactions, and all the respiration of the animals of the world, he said, Priestley had, with characteristic modesty, spoken of having "by accident hit upon a method of restoring air," and some of his biographers had foolishly taken him at his word. Alluding to Priestley's record that "Nothing would be easier than to augment the force of fire to a prodigious degree by blowing it in with dephlogisticated instead of common air; from the greater strength and vivacity of the flame of a candle in this pure air it may be conjectured that it might be peculiarly salutary to the lungs in certain morbid cases," Dr. Dufton remarked that it was curious that this line of research had been almost completely neglected. "Oxygen had, it is true, been used as a last resort in pneumonia," he said, "but the serious treatment with oxygen was for the first time used in the war, when researches in the Cambridge physiological laboratory by Mr. Barcroft and my daughter led to the treatment of gassed soldiers in chambers containing a highly oxygenated atmosphere, with very remarkable results."



## Society of Glass Technology

### First Meeting of the Session

THE first meeting of the Society of Glass Technology for the session 1923-24 was held in Sheffield on October 17, the President, Professor W. E. S. Turner, D.Sc., in the chair. The initial formal business included the presentation of "Frank Wood" medals to Mr. A. R. Sheen, B.Sc.Tech., and Mr. F. Winks, B.Sc.Tech. The presentation was made by Sir W. H. Hadow, C.B.E., M.A., D.Mus., Vice-Chancellor of the University of Sheffield. The design of this medal was the work of Mr. Percy Metcalfe, a former pupil of Professor W. Rothenstein, Professor of Civic Art in the University of Sheffield. Professor Rothenstein, who was welcomed to the meeting, pointed out that it had been the custom during the last century when new medals were struck, to go to France for them, but whenever an Englishman got his chance he showed that he could do this work much better than anyone else. People would not realise that to have faith in their own contemporaries was one of the first duties of citizenship.

The President referred appreciatively to the hospitality experienced by members who visited France during the first week of July. It was resolved to send a cordial invitation for a conference in this country sometime during 1924, jointly to members of the Society in France and to the *Chambre Syndicale des Maitres de Verreries* (the representative body of French manufacturers who had welcomed the party to Paris).

### Titania and Silica in Glass

A paper entitled "The Effect of Titania on the Properties of Glass," by A. R. Sheen, B.Sc.Tech., and Professor W. E. S. Turner, D.Sc., was given by Mr. Sheen and illustrated by lantern slides. In presenting this paper, Mr. Sheen remarked that a great deal of interest had recently been shown in the production of heat resisting glass. Manufacturers, especially of scientific glassware, were realising the necessity of making a glass which had a high thermal endurance and which at the same time was capable of resisting the attack of substances with which the glass came into contact, whether solid, liquid or gaseous. Modern heat resisting glasses contained a high percentage of silica, and also boric oxide in considerable amount—e.g., the well-known glass, Pyrex (which owed its high thermal endurance to its exceptionally low co-efficient of expansion, 0.000032), contained approximately 80 per cent. silica and 12 per cent. boric oxide. There were, however, objections to the use of these oxides. In the case of silica the difficulty was merely one of obtaining a sufficiently high melting temperature. On the other hand, glasses containing boric oxide were very readily melted, but here the objection was the effect of the oxide on the durability of the glass. Recent research in the Department of Glass Technology of Sheffield University had shown that as the  $B_2O_3$  content of a glass was increased the durability towards water and acid increased to a maximum, and then as the  $B_2O_3$  content was further increased the durability fell off rapidly. Boric oxide containing glasses (and, of course, glasses with high silica content), on account of their acidic nature, were very readily attacked by alkali—e.g., it was quite useless using Pyrex ware as an alkali container. What information there was concerning the use of titania in the production of glass seemed to point to the fact that titania glasses were heat resisting, but no experimental data were given. It was with this consideration specially in mind that this piece of work was undertaken.

### Heat Resisting Properties

At the outset preliminary tests were made to find out what mixture of silica, titania and soda would give glasses at the highest temperature obtained in glass melting practice—e.g., temperature of 1,400° to 1,450° C. There were indications during these melting operations that titania glasses were heat resisting. It was found in many cases that the glass could be removed straight from the furnace and allowed to cool down in the open air without splintering or cracking of the mass of glass occurring.

After considering the analyses of these six glasses, the first question dealt with was the durability of the titania glasses towards water. It was found, on comparing with the corresponding lime and magnesia glasses, that the titania glasses

were less attacked than the lime glasses, especially in the earlier members of the series. The durabilities of the titania glasses were found to be practically the same as those of the corresponding magnesia glasses.

The annealing temperatures were found to be rather less than those of the corresponding lime and magnesia glasses.

Next, the important question of thermal expansion was dealt with. It was originally intended to determine this optically by the Fizeau-Pulfrich method, but after discussion it was eventually decided to repeat the melts on a large scale (28 lb. pot), to draw tubing and determine the expansion by the ordinary dilatometer method. The thermal expansions of these titania glasses (only the first four glasses of the series were tested) were only slightly less than those of the corresponding lime glasses. Therefore if titania glasses are heat resisting it is certainly not due to their having a low expansion, as is the case with Pyrex glass, for example, but the cause must be sought in some other factor, such as tensile strength or elasticity. These glasses possessed good working properties, their viscosity increasing as titania replaced soda. Throughout all the glasses melted in connection with this work there was hardly any evidence of devitrification occurring. This bore out the statement of previous workers that titania hindered devitrification.

### Estimation of Selenium

Mr. A. Cousen, B.Sc., A.R.C.S., then gave a paper entitled "The Estimation of Selenium in Glass." Illustrating his remarks with experiments, Mr. Cousen said that during the course of researches on the use of selenium as a decolourising agent, it was found desirable if possible to obtain a process for the estimation of selenium in the glasses obtained. The amount of selenium actually added to the batch was, in general, of an order sufficient to give only 1 part of the element per 42,000 parts of glass, or 0.0024 per cent. if no loss occurred. Since, however, selenium was volatile at the temperature of the furnace (the boiling point at 1 atmosphere pressure is 680°), values considerably less than the above were likely to be found. The only chemical method for estimating selenium in glass so far published was that of Fränkel and described by Witt (Sprechsaal, 1914), and this was not quite comparable since it dealt with proportions of selenium at least ten times as great as those it was desired to estimate. The following modification of the above process was found to give results of fair accuracy. Twenty grams of finely powdered glass were dissolved slowly in hydrofluoric acid, and after standing in the cold, with the exception of selenium, the products of decomposition were dissolved by pouring into excess of boiling water. The selenium itself was filtered off on a filter pulp pad in a Gooch crucible. From the pad the selenium was removed by treating with a dilute chlorine solution (about one three-hundredth normal). To the filtered solution was added 1 cc. of 5 per cent. gum arabic and 5 cc. of half per cent. phenyl hydrazine hydrochloride—the whole being made up to 50 cc. Colloidal selenium was obtained, a yellow colour slowly developing, which was after half an hour matched against a standard solution of sodium selenite similarly treated. The method on testing with synthetic mixtures gave results well within 0.0002 per cent. of the actual values, and a commercial glass, for which selenium had been used, sufficient to give theoretically 0.0025 per cent., was found to contain actually only 0.0006 per cent. of the element.

### The Use of Sulphur in War

PROFESSOR J. R. PARTINGTON, in a letter to *The Times* on Tuesday, drew attention to a point in Mr. Winston Churchill's recent book where, in his account of Lord Dundonald's proposal to burn sulphur to windward of the enemy, he says: "I notice also with some misgiving attempts by the German Government to purchase sulphur on an exceptionally large scale," which would seem to imply that some such idea was being entertained by them. Professor Partington pointed out that this was highly improbable; the German Government were much better acquainted with chemistry to do any such thing, as later events showed. The sulphur required by the German Government was probably required for the manufacture of sulphuric acid, which was used in immense quantities for the manufacture of explosives.

## Society of Chemical Industry

### Nottingham Section

THE opening meeting of the Session was held on Wednesday, October 17, when the Chairman (Mr. Wilkie) delivered an address on "Some reflections on the importance of Chemistry to the community, and the means which should be adopted to bring the fact home to the man in the street."

Mr. Wilkie referred to the publicity given to the importance of chemistry during the war, but very little reference to this subject had been made by the Press subsequently. He mentioned some vital questions, which were being actively investigated by chemists, such as the close connection between dietetics and deficiency diseases, and the importance of extending our knowledge of the various vitamins. The problem of the exhaustion of the soil was still unsolved in so far as the replenishing of very necessary supplies of potash and phosphates was concerned. Public notice should be frequently brought to such investigations, so that the community would realise the importance of chemistry, and the vital problems which were being attacked by members of this profession.

In the discussion which followed, as to the ways in which the real meaning of chemistry could be made known more widely, it was generally agreed that the first step was the popularising of the subject in the schools.

Dr. J. B. Firth and Mr. G. F. Higson then presented a paper on the action of aqueous sodium hyposulphite (still known commercially as "hydrosulphite") upon silver chloride. In the case of solid silver chloride the action was very slight, but this action increased with temperature (up to a maximum of 50°C.) and concentration of the hyposulphite, the main products being silver sulphide and metallic silver. The reaction between hyposulphite and silver chloride dissolved in sodium thiosulphate solution, produced silver sulphide in quantitative amounts according to concentrations. This reaction could be utilised for the recovery of silver from silver residues, as the silver sulphide was readily converted into a bead of metallic silver on lightly fusing. Silver chloride dissolved in excess of ammonium hydroxide solution was rapidly and quantitatively reduced by hyposulphite to metallic silver in a finely divided condition, and thus another method presented itself for the recovery of silver residues. The silver obtained by this reduction was very easily fused into a metallic bead. A similar quantitative reduction to metallic silver (finely divided) occurred when silver nitrate solution, dissolved in excess of ammonium hydroxide, was treated with aqueous sodium hyposulphite.

### Mass Production in Industry

"WITHOUT mass production we cannot produce enough to sell at a price that will enable us to import and pay for our food." This was the reply made by Sir John Dewrance in his presidential address to the Institution of Mechanical Engineers to the "great arguments" which he said were advanced, both by artists and skilled workmen, against mass production and automatic machines, on the ground that such production eliminated the opportunity for individual skill. Other countries, he pointed out, adopted it, and found it a necessity. "In foreign countries," he said, "standardisation is making progress, not perhaps so much in the direction of standard qualities of the materials used by engineers as the smaller component parts. In this country attention has been directed more to the former than to the latter, and our members might do much to bring about further economy in the workshops of the country by surveying the broad field of mechanical engineering generally and making suggestions to the British Engineering Standards Association for work of standardisation in this direction. The great idea is, of course, to arrive at international standards, and this is coming. There is practically such a standard for the tubes of oil wells, and efforts are being made to get other international standards. The British habit of mind does not readily accept standard products, but prefers something made specially. This interferes with mass production. Buyers for export generally prefer the standard product, as it is more conveniently replaced. Our manufacturers have had many severe lessons which suggest that in the future countries that can accept and produce standard products by mass production will be most successful."

## The Future of Iron and Steel

### Chemical Developments

SPEAKING at the opening of the winter session in connection with the Staffordshire Iron and Steel Institute, at Dudley, on Friday, Mr. F. J. Cook (Messrs. Rudge Littley, Ltd., West Bromwich) said a great deal of work needed to be done in blast-furnace. They needed to know a great deal more in regard to the proper relationship to each other of blast, volume, pressure, and temperature, and their effects on the suffusion and diffusion throughout the product, of the various elements, particularly carbon. The economic side of their industry was of vital importance, and much larger advantage ought to be taken, with a view to profitable production, of what were usually termed the by-products. Slags during the past few years had been much more largely used, especially as macadam, tarred and otherwise, for road-making, and were valued as agricultural fertilisers. The capabilities of the blast-furnace as a producer of motor spirit had hardly yet been realised, but it was clear that in this direction a wide field of opportunity was gradually opening up. The modern motor-car had been made possible largely through the production of high quality steel and other metals, and it would be a kind of reciprocal justice if the motor, by using largely petrol or some other motive spirit produced from the blast-furnace by-products, should be a source of strength and profit to the iron and steel trades.

### Corrosion of Steel

In recent years a great deal of specialised research had been devoted to steel, but in this department very special attention needed to be devoted to corrosion and its prevention. In regard to the so-called corrugated iron sheet—usually made from steel—it was common knowledge that the life of the modern sheet was only about one-third that of the old-fashioned sheet made from reliable Staffordshire iron. It was most urgent that research work should be done having for its object the introduction of a special steel possessing essentially durable qualities, and the ideal in view should be its production without any material addition to cost. So far the galvanised sheet had held the field, no adequate substitute for the spelter coating having been found, but a galvanised sheet was, after all, a sort of makeshift, and the preliminary pickling in powerful acids in itself introduced an element of danger, which occasionally, no doubt, helped to shorten the life of the sheet. The day ought to be not far distant when a material possessing inherent durable qualities should be placed on the market, putting an end to the expensive and unsatisfactory process of galvanising.

### Standard Specifications

The questions of mechanical tests and standard specifications required an attention which was long overdue. The present bases of chemical specification required revision. It seemed clear that if certain specified physical tests were met a much wider range of chemical composition might be permitted. With regard to cast-iron, the question of testing might, without unfairness, be described as chaotic. In this connection it was reassuring to know that a suggested specification had been drawn up by a special committee of the Institute of British Foundrymen, and it was hoped that some tangible results might accrue enabling a standard to be set up upon the comparative results obtained in the various works of this country and abroad. At present the results of tests as they were usually published in connection with cast-iron were too often scarcely worth the paper they were written upon, owing to the lack of standard conditions to be observed equally in connection with manufacture and testing.

### Unemployment Totals

THE number of persons recorded on the live registers of the employment exchanges in Great Britain on October 15 was 1,253,900. This was 2,372 more than in the preceding week, but 231,978 less than the figure recorded on January 1, 1923. The total included 936,400 men, 42,600 boys, 235,900 women, and 39,000 girls. In addition, the number working systematic short time and drawing benefit for intervals of unemployment was 64,300 on October 15, as compared with 66,145 on October 8 and 56,261 on January 1, 1923.



## The Birmingham Chemical Society

### The Chemistry of Starch

THE opening meeting of the University of Birmingham Chemical Society for Session 1923-4 was held on October 15. The President, Professor G. T. Morgan, O.B.E., D.Sc., F.R.S., was in the chair. The prizes for last session were awarded as follows:—Frankland Medal and Prize, Mr. O. C. Elvins, B.Sc.; President's Prize, Mr. E. Holmes, B.Sc.; Vice-Presidents' Prize, Mr. A. R. Bowen, B.Sc.; Society's Prize, Mr. R. B. Tunstall, B.Sc. An address was then delivered by Professor A. R. Ling, M.Sc., F.I.C., entitled "Some Recent Advances in our Knowledge of the Chemistry of Starch."

The lecturer commenced with a brief account of the historical work on starch, leading up to his own work in conjunction with Mr. D. R. Nanji. The results of their research show that of the two constituents of starch, amylose and amylopectin, the latter is in all probability a phosphoric ester. The constitution of amylopectin was discussed, and it was shown that this can be converted by enzyme action to  $\alpha$  glucosidoisomaltose or  $\beta$  glucosidomaltose. Further enzyme action converts this hexatriose to either isomaltose and glucose or maltose and glucose according to the enzyme employed. Thus the research bears out the view of Pringsheim, Karrer and Irving that starch consists of polymerised non-reducing substances named by Pringsheim amyloses. The conclusion of S. B. Schryver that certain starches contain hemi-cellulose complex is also confirmed by their work.

## Steaming Coal in Vertical Retorts

### Work by the Fuel Research Board

A REPGRT recently issued by the Fuel Research Board\* describes the carbonising tests that have been carried out in the setting of Glover-West vertical retorts on special consignments of Arley coal, South Lancashire.

In the first tests the four retorts in the setting were all in use, but when No. 2 developed a leak the series was completed, using three retorts only. This change seemed to have some slight effect on the results as discussed in the report.

The coal proved to work quite well in the retorts so far as handling and carbonisation were concerned, though at higher percentages of steam the temperatures in the upper part of the retorts tended to become rather high. This had a bad effect on the ammonia yields, and increased steaming above approximately 10 per cent. did not result, as might otherwise have been expected, in any additional recovery.

The amount of heat required per ton for the carbonisation of this coal, including the sensible heat in the products, varied from 13.0 therms with 5 per cent. steam to 18.25 therms with 20 per cent. steam. The intermediate points were not obtainable owing to the amount of heat which was taken up by the setting when only three retorts were in use being unknown.

The ash of the particular consignment of Arley coal supplied was found to be fusible at a temperature of about 1090° C. That this property is typical of the ash of all coal from the Arley seam is unlikely, but other investigators have shown that ash of this composition is quite commonly met with (Bone, *Coal and its Scientific Uses*, p. 40, and Sinnatt, *Journal of the Society of Chemical Industry*, vol. 40, No. 1, p. 21).

The general effect of steaming on carbonisation yields may be summarised as follows for increases from 5 to 20 per cent. of steam.

	Steam.	5 %	20 %	Increase.	
				Actu.	%
Gas, cubic ft. per ton	.....	15,980	19,980	4,000	25.0
Gas, calorific value B.Th.U's	.....				
per cubic ft.	.....	502	457	-45	-9.0
Gas, therms per ton	.....	80.2	91.3	11.1	13.9
Tar, gallons per ton	.....	13.62	14.73	1.11	8.1
Ammonium Sulphate, lbs. per ton	.....	23.43	28.57	5.14	21.9

\* The Steaming of Wigan Arley Coal in Vertical Gas Retorts. H.M. Stationery Office, Fuel Research Board Technical Paper, No. 8. 9d.

## A Chemical Theory of "Ball Lightning"

### An Interesting Suggestion

FROM time to time one sees in the daily press and occasionally in scientific journals, circumstantial accounts by people who say they have seen a ball of fire, or globular lightning as it is called. Occasionally the particulars are given in considerable detail by observers who have scientific knowledge, and also by others who are not given to imagining or exaggerating what they see. It seems to me, therefore, that the attitude of pooh-poohing the matter and saying that it is merely an optical illusion is not justified; the accumulation of evidence is much too great for that.

I believe that the ball is concentrated on possibly liquid nitric oxide gas, which has been made by relatively short flash from a low-lying cloud to earth. Certainly all the observations fit in well with the formation and action of such gas. We know that when air is passed through an electric arc flame in a large electric furnace the nitrogen and oxide combine to make nitric oxide gas, which as it cools down begins to take up more oxygen and forms nitrogen dioxide.

We also know that when lightning strikes through the air it also makes nitric oxide, and it has been estimated that annually over 100 million tons of nitrogen fixed by lightning flashes fall on to the earth's surface. The energy suddenly released by a flash is enormous, and the pressure has to be millions of volts so as to tear a way or a hole through the air dielectric. I expect that momentarily a very high pressure is set up, and immediately followed by a reaction, which gives a sudden chilling effect. If that be so then the conditions are extremely favourable to the production of a large amount of nitric oxide gas in a very concentrated and probably liquid form.

Lightning is of two kinds, namely, flashes between a cloud and earth and flashes between clouds. When the first occurs the cloud has first to come relatively close to the ground, and that is why there is darkness just before a storm, also the most violent flashes occur before the rain has had time to lower the tension by discharging piecemeal in raindrops.

Assuming that highly concentrated or liquid nitric oxide gas is rolled up as it were into a ball by such a lightning flash, then owing to its density it would gravitate slowly downwards in exactly the way that observers say they have seen. Also whilst doing so the outer layer of gas will be oxidising to nitrogen dioxide and this will dissipate in the air; and if the length of travel through the air is long enough it will all disappear in that way. Occasionally, however, the ball of gas will start to fall from a point so near the earth that some of it is still in the form of a ball of concentrated nitric oxide when it arrives at earth level.

If it meets with some organic material, such as a haystack or a tree, which it can nitrate, we know exactly what should happen because that is one way in which explosions are made. The nitrating and the explosion would take place practically simultaneously, for when liquid nitrogen dioxide comes in contact with organic matter it produces a most violent reaction.

E. KILBURN-SCOTT.

## Proposed New Sugar Beet Factory

OVER £42,000 has been subscribed in Kidderminster towards the £50,000 to be raised locally for the proposed sugar beet factory at Kidderminster. The promoters of the scheme have had to seek outside financial assistance—Mr. van Rossum, a Dutchman with big beet-sugar interests in Holland, who has already started successful factories in this country, is finding the biggest portion of this money—and it is a condition of this assistance that the above named sum should be raised locally by a certain date. The promoters have endeavoured to raise the rest of the money within the few days remaining. The farmers have consented to provide the necessary acreage of sugar beet, and Kidderminster Corporation have offered suitable land on the Worcester Road. Emphasis has been laid on the question of time, because a guarantee was given that the factory should be erected in time to deal with the beet crop of 1924. To secure that result an almost immediate start will have to be made in connection with the building. There is a general impression that if the money is not forthcoming the scheme will be dropped and is not likely to be revived again, at any rate for some years.



## Sulphate Federation's Action Against the South Metropolitan Co.

### Suggested Reference to Accountants

ON Thursday, in the King's Bench Division, Commercial Court, before Mr. Justice Greer, Mr. R. A. Wright, K.C., mentioned the case of the British Sulphate of Ammonia Federation, Ltd., v. the South Metropolitan Gas Co.

Mr. Wright said he appeared in this case for the plaintiffs with his learned friends Mr. Jowett, K.C., and Mr. Le Quesne, and Sir John Simon, K.C., Mr. Raeburn, K.C., and Mr. Wyllie represented the defendants. The action was of a difficult and complicated character relating to the proper method of keeping accounts in a pooling system and the price realisation system adopted as a consequence of the war. His learned friends and himself thought that if the matter were allowed to stand over till Wednesday next, it would be possible to dispose of the whole action by having it referred to two eminent accountants who could deal with it on certain principles to which the parties assented, and without prejudice to the evidence. Under these circumstances counsel asked that the matter should stand out till Wednesday morning next, when they would again mention the case. They all felt that this was the proper course to adopt in this case.

His Lordship assented to the course suggested, but added that should the case come into the list for trial on Wednesday next it would be subject to any case that was then part heard.

Mr. Raeburn agreed with all that Mr. Wright had said.

### Chemical Industry Problems

ADDRESSING the Western (London) Pharmacists' Association last week on "British chemical industry and the pharmacist," Mr. W. J. U. Woolcock pointed out that the war had led to a reorganisation of British industries. There was no branch of the chemical industry which did not supply something in daily use in pharmacy. The industry, with a capital of one hundred and fifty millions, was composed of twelve groups, each independent units yet interdependent. Moreover, each had its particular policy, but the interests of the whole were looked after by a council with representatives of each section. In this way the decisions arrived at were excellent, and, apart from the interlocking of capital, Mr. Woolcock considered there was no better organisation anywhere. The biggest problem to-day in the chemical industry was the attempt to deflate plant capacity from the high war production to normal requirements. This trouble was world-wide. In the heavy chemical industry Great Britain had always been pre-eminent, and this had merely to be maintained. In the war the Germans erected the Badische Haber plant, and Britain's reply to this was the building of the enormous ammonia works at Billingham. The plant there turned out 100 tons of ammonia daily, but could produce 300 tons if required. As regards sulphuric acid, it was of interest to note that the trend of manufacturers was to abandon pyrites and use sulphur. Eight Government factories were erected during the war for wood distillation, but at present there was no waste wood, and we were again compelled to go abroad for such products as acetic acid and acetone. The opinion was held, however, that the natural product would have to give way to the synthetic, and so this country would again become self-supporting in that respect. To develop an industry one of the first essentials was co-operation. Another important factor was publicity. He did not think anything similar to what was being attempted at the British Empire Exhibition had ever been attempted by any other nation.

### Oil Extraction Problems

IN our issue of October 13 it was stated that "solvent extraction, while offering the best solution to the problem of recovery from oil-bearing waste products, has not hitherto been successfully applied in many cases, notably fuller's earth used for bleaching or filtering purposes." It has been pointed out to us that this is, while doubtless made in good faith, inaccurate, for, to mention only one case, not only does the "Scott" patent system for dealing with fuller's earth and similar substances successfully and economically accomplish the end desired, but numerous installations have been supplied all over the world, which are daily carrying out the process in a most successful manner.

## English Beet Sugar Corporation

THE seventh annual general meeting of the English Beet Sugar Corporation was held in London on Tuesday. The chairman, in the course of his speech, pointed out how splendidly Mr. van Rossum, the founder of the beet sugar industry in England, had stood by the company, both in the early stages when the risks were incalculable, and subsequently when heavy losses were made and the future seemed almost hopeless. Mr. van Rossum had all along invited the co-operation of British capitalists, but the response has been small, the consequence being that he had been left to undertake an immense financial burden almost single-handed. The net profit for the year was £103,981. Deducting this sum from previous accumulated losses of £118,940, there was still a debit on profit and loss account of £14,958. They hoped to wipe this off in the current year, also to reduce, or, better still perhaps, to extinguish the £20,952 which stood in the balance-sheet under the heading of maintenance account, administration and interest charges to March 31, 1920. As there was still a debit on profit and loss account, they could not, of course, pay any dividend in respect of last year on the ordinary shares, nor did they recommend a dividend on the cumulative preference shares. The debenture-holders, however, would receive the benefit of an additional 2½ per cent. interest under the terms of the debenture trust deed.

### Famous Lead Mines Sold

THE proprietors of the Van Lead Mines, near Llanidloes (Montgomeryshire), have sold the plant and machinery at the mine, and it will shortly be dismantled and removed. The Van is, with Great Laxey (Isle of Man) and Minera (Flint), one of the three largest lead mines in Great Britain. At one time it employed 1,000 men, and was a veritable El Dorado, an immense fortune being made in 1870, when the shares of £4 5s. each rose in a few months to the phenomenal figure of £84 each. The mine has been idle since May, 1920. The General Manager (Mr. Thomas Miller) states that since 1916 the company has spent £20,000 on additional plant and machinery, and £24,000 on development underground. "That enterprise and capital," Mr. Miller added, "has been thrown away owing to the action of the Government. British lead and zinc mining at the present time is, to all intents and purposes, dead. Before the war there were about 350 mines on the Home Office list. Most of them were being worked. To-day not half a dozen are being worked, and thousands of men have been thrown out of employment. This state of affairs is entirely due to the contracts the Government entered into in 1917 to take practically the whole of the output of the Australian mines until 10 years after the legal termination of the war, i.e., 1930. The Government is selling the concentrates imported from Australia to British smelters at a price which has entirely cut off the market to the home producer at a remunerative price, and British mines have, therefore, had to close down. The action of the Government has not only killed the home industry, but on the showing of a Departmental Committee has resulted in a huge loss to the taxpayer owing to the price at which the imported concentrates are sold to the smelters."

### New Arsenic and Gold Ores

THE discovery of an ore body, 30 ft. to 49 ft. wide, and assaying 30 oz. of silver and \$2.80 in gold per ton, near Kanaka, nine miles east of Lytton, British Columbia, is reported. A strong vein heavily mineralised with arsenical pyrites and said to assay \$30 in gold and 20 per cent. of arsenic has been exposed in the same neighbourhood.

### Recent Wills

Mr. Thomas Trahern, proprietor of the Aluminium Castings Foundry, Coventry .....	£5,163
Mr. Edward Josiah Davy, of 2, Florenceville, Parkfield Road, Rotherham, managing director of Humphrey Davy's, Ltd., wholesale and retail chemists .....	£4,433
Mrs. Phoebe Sarah (or Hertha) Ayrtton, of 41, Norfolk Square, Hyde Park, London, W., inventor of the "Ayrtton Flapper" (used for dispersing poison gas during the war) .....	£8,160

## From Week to Week

MR. M. DIXON, of Emmanuel College, Cambridge, has been appointed senior demonstrator in bio-chemistry.

CONSIDERABLE DAMAGE by fire has been done to the chemical laboratory of the Wigan Grammar School,

THE DATE of the Chemical Industry Club annual dinner to be held at the Connaught Rooms, London, has been changed from Friday, November 23, to Monday, November 26.

MR. A. E. MALPAS, chief engineer to the United Alkali Co., Ltd., in an address to the Widnes Scientific Society last week, advocated the adoption of the metric system in chemical works.

THE GENERAL ELECTRIC Co. of New York has given \$5,000 and the British Thomson-Houston Co. £250 for promoting original investigations at the Cavendish Laboratory, Cambridge.

AS A RESULT of the rise in the cost of living, the operative dyers in Yorkshire and Lancashire are to receive an advance in wages of 5 per cent., in accordance with the sliding scale agreement.

THE SALTERS' INSTITUTE of Industrial Chemistry has awarded 64 grants in aid to chemical assistants, occupied in factory or other laboratories in or near London, to facilitate their further studies.

A TANK containing 40 tons of molten glass exploded on Sunday night at the works of Chance Bros. and Co., glass manufacturers, Smethwick. A fire was quickly extinguished by the works brigade.

W. H. WILLCOX AND CO., LTD., 38, Southwark Street, London, S.E.1, have registered the following new telegraphic and cable addresses:—Telegrams, "Enginsplys, Boroh, London"; Cables, "Enginsplys, London."

PROFESSOR J. W. MCBAIN, of Bristol, has received the degree of doctor of science from Brown University, Rhode Island, United States, where he delivered a dedicatory address at the opening of the new chemical laboratories.

MR. WILLIAM ASPDEN, who was the founder of a chemical manufacturing business well known in Lancashire and Yorkshire, died at Morecambe last week in his 93rd year. In addition to his business activities, which he maintained almost up to the end, he took a considerable part in the public life of the district.

AT THE LAST MEETING of the Board of the Institute of Physics the following corporate members were elected:—*Fellows*, G. R. Bolsover, J. A. Jones, C. H. Lander, T. Takamine and A. Warren; *Associates*, K. R. Brain, A. L. Gregson, J. S. Grew, J. A. Hughes, E. O. Hercus, T. J. Lonsdale, R. D. Thompson and J. F. Wood.

THEO AND CO., of 6, Hatton Garden, Liverpool, announce that they have again reduced the price of their "Electro-Automate" magneto pocket lamps to 18s., which includes a spare bulb incorporated in the lamp. They have also reduced the price of their ingenious "Universal" combined blow lamps and soldering irons to 30s. and 20s. respectively.

THE ABERDEEN TOWN COUNCIL have referred to the Public Health Committee applications by the Albumenoid Products Co., Ltd., and Allan and Day for permission to establish fish meal factories in the city. Objection was offered from several quarters, and it was stated that if all the recent applications were granted there would be five fish meal factories in the district.

THE SIXTH annual general meeting of the British Association of Chemists will be held at the Chemical Department, University of Birmingham, Bournbrook, to-day (Saturday). A chemical exhibit has been arranged by Professor G. T. Morgan, to precede the meeting. The society's annual dinner will be held at the Queen's Hotel, Birmingham, during the evening. The president, Dr. H. Levinstein, will take the chair at both the general meeting and the dinner.

THE PROGRAMME of the Chemical Association of the Northern Polytechnic Institute, London, for the winter session, which opened on Tuesday with a paper by Sir Robert Robertson, F.R.S., on "Trinitrotoluene," includes also future papers on "The Sources of Raw Material for Chemical Manufacture," by Dr. J. T. Hewitt, and "The Organisation of Research in a Chemical Works," by Dr. H. A. D. Jowett, on December 11 and May 6 respectively.

Sir JOHN RUSSELL, Director of the Rothamsted Experimental Station, Harpenden, is about to leave England on a special mission to the Soudan. He will be associated with Dr. H. Martin Leake, Director of Agriculture in the United Provinces of India, in advising the Soudan Government on its agricultural research policy. In view of the enormous possibilities for growing cotton in the Soudan, agricultural research work will be mainly concerned with cotton.

AT THE MEETING of the Manchester section of the Society of Dyers and Colourists, to be held at the Textile Institute, St. Mary's Parsonage, Manchester, on November 2, at 7 p.m., the subject of "Electrometric Methods in Analytical Chemistry" will be dealt with by Professor W. D. Treadwell, Ph.D., of the Federal Technical High School, Zurich. This is a joint meeting with other societies and the chairman of the Society of Dyers and Colourists (Mr. W. Marshall) will preside.

THERE WAS a large attendance of members of the Sheffield Association of Metallurgists and Metallurgical Chemists at the club in West Street, on Wednesday, October 17, to hear a paper on "Chemical Control of Gas Producers," read by Mr. J. A. Clements, F.I.C. The paper dealt with a consideration of ideal conditions in producer practice, chemical and thermal balance sheets, function of steam used in blast and the probable utilisation of other gases, and problems in analytical control. The President (Mr. B. W. Methley) was in the chair.

AT A MEETING of the Physical Society in London on Friday, the papers read included one by Messrs. S. H. Piper, B.Sc., and E. N. Grindlay, B.Sc., on "The Fine Structure of Sodium Salts of the Fatty Acids in Soap Curds." They stated that X-ray photographs of certain sodium salts of the fatty acids (soap curds) showed lines due to reflections from planes with very wide spacings of the order 40 Å.U. These planar spacings increased uniformly with the number of CH<sub>2</sub> groups in the molecule, indicating an effective length of 1.25 Å.U. for the C.H<sub>2</sub> group. These and other lines could be accounted for by assuming that the curds are in the smectic state described by Friedel.

THE PROGRAMME of the Chemical Society of Birmingham University for the coming session includes a number of lectures on subjects of chemical interest. Mr. F. J. Corby is to read a paper on "Perfumes," on October 29; Mr. V. E. Yarsley on "Colour and Chemical Constitution," on November 12; and Mr. C. J. A. Taylor, B.Sc., on "Chemical Theories of Atomic Structure," on November 26. A paper is also to be read by Mr. A. Appleyard, the subject not yet having been fixed. In the second half of the session there are to be papers on "Glass and its Chemical Nature," by Mr. D. G. Skinner; "Vitamins: their Chemistry and Importance to Life," by Mr. G. E. Forstener; "Atomic Weights and Isotopes," by Dr. F. W. Aston, F.R.S.; and "Ionisation in Non-aqueous Solvents," by Mr. R. L. Wormell.

AT THE STATUTORY MEETING of the Royal Society of Edinburgh on Monday the following officers were elected:—President, Professor F. O. Bower, D.Sc., LL.D., F.R.S.; vice-presidents, Major General W. B. Bannerman, C.S.I., I.M.S., M.D., D.Sc.; Mr. William A. Tait, D.Sc., M.Inst.C.E.; Principal James C. Irvine, C.B.E., LL.D., F.R.S.; the Right Hon. Lord Salvesen, P.C.; Professor J. H. Ashworth, D.Sc., F.R.S.; Professor T. Hudson Beare, B.A., B.Sc., M.Inst.C.E.; general secretary, Professor R. A. Sampson, D.Sc., F.R.S.; secretaries to ordinary meetings, Mr. Alex. Lauder, D.Sc., and Professor W. Wright Smith, M.A.; treasurer, Mr. James Currie, M.A., LL.D.; and curator of library and museum, Mr. A. Crichton Mitchell, D.Sc. Afterwards the President delivered an address on "The present outlook on descent."

SIR ALFRED EWING, principal of Edinburgh University, speaking at a graduation ceremony on Saturday, October 20, referred to the extension of the chemistry accommodation, on which, he said, nearly £180,000 had been spent. Of that sum nearly £100,000 had been found, but the balance was at present an overdraft, and he appealed to any liberal donor to come forward and relieve them of that burden. Or, if the donor preferred it, there were other departments on which the money could be spent. After the war, he added, they had an embarrassing influx of students, especially in the science departments, but compared with last year they had this year an entry of 300 less, and were likely to revert, if not to the standard of numbers they were accustomed to before 1914, to a more manageable standard. It was in the departments of science and medicine that the reduction was most marked.



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### Abstracts of Complete Specifications

203,709 and 204,290. CHROMATES AND BICHROMATES, MANUFACTURE OF. A. J. B. Jouve, 1, Boulevard St. Germain, Paris; A. Helbronner, 78, Boulevard Malesherbes, Paris; and Soc. Hydroelectrique and Metallurgique du Palais, 11bis, Rue Roquepine, Paris. International Convention date, November 23, 1921, and Application date, March 17, 1922. Addition to 177,174.

203,709. The process is for obtaining chromates and bichromates by the electrolysis of a chrome alloy in an electrolyte of alkali carbonate, by the method described in Specification No. 177,174 (see THE CHEMICAL AGE, Vol. VI., p. 668). The chromate is formed as a neutral chromate in regularly increasing proportion as the electrolysis proceeds, until the carbonate has disappeared. The chromate then functions as the electrolyte and a second molecule of chromium is dissolved, the neutral chromate being converted progressively into bichromate. The concentration of bichromate does not affect the electrolysis, which may proceed until the concentration is such that crystallisation takes place on cooling. If the chromate is required, the bichromate obtained in this manner may be converted into neutral chromate by treating with neutral alkali carbonate. Alkali bichromate may thus be obtained from ferrochromes by electrolysis, and concentration of the solution may be effected during electrolysis by adding carbonate. The iron oxide is separated from the solution by filtering, and the chromate or bichromate then crystallised. The electrolysis may be carried out with such current concentration that the electrolyte becomes heated by this means.

204,290. In this invention, instead of using anodes of cast or moulded ferrochrome for obtaining chromates or bichromates, the anodes may consist of briquettes formed from the mineral chromite with an agglomerant such as tar. The briquettes are heated to reduce partly the oxide of chromium, but without fusion. The electrolysis may be carried out with alternating current, provided the current density is very high. When ferrochrome is employed, the chromium content must be at least 40-45 per cent.

204,078. LIQUID HYDROCARBONS, TREATMENT OF. A. E. Dunstan, Meadhurst, Cadbury Road, Sunbury-on-Thames. Application date, April 22, 1922.

The object is to purify aliphatic liquid hydrocarbons containing unsaturated bodies such as cracked spirit, to obtain a motor fuel. The hydrocarbon is treated with chlorine water or an aqueous solution of hypochlorous acid, and then with alkali to hydrolyse the chlorinated bodies. The cracked spirit is washed with hypochlorous acid solution in a washer of the usual type, and the sulphur and nitrogen compounds are thereby oxidised. Alternatively, the reaction products of the olefine bodies may be isolated after steam distillation, and hydrolysed with strong alkali to convert them into their oxides, which are then added to the saturated hydrocarbons. If the proportion of diolefine bodies in the cracked gasoline is high, it may be first filtered through a mineral adsorbent such as bauxite, or treated with anhydrous aluminium or zinc chloride, or with mineral acid, to polymerise the more active unsaturated hydrocarbons. The gasoline is then chlorinated. This process converts the unsaturated bodies first into chlorhydrins and the like, and then into ethers.

204,093. PAINTS, MANUFACTURE OF. S. R. Trevor, Sulphur Beach, Auckland, New Zealand, and J. E. Moosman, Bloomfield Road, Epsom, Auckland, New Zealand. Application date, June 12, 1922.

Indiarubber in any form, but preferably waste rubber containing filling material, is dissolved in a solvent such as linseed oil, turpentine, kerosene, or benzene, at 140°-170° C., and the mixture then heated to 200° C. for some time, and finally to 260°-310° C. This solution is then mixed with not more than 75 per cent. of water by agitation, until an intimate mixture is obtained. The usual pigments may be added. Reference is directed in pursuance of Section 7, Sub-section 4, of the Patents and Designs Acts of 1907 and 1919, to Specifications Nos. 18,499/1906, 151,687 and 175,764.

204,108. NEW DYESTUFFS CONTAINING SULPHUR, PRODUCTION OF. R. B. Ransford, London. From L. Casella and Co., G.m.b.H., Frankfurt-on-Main, Germany. Application date, June 19, 1922.

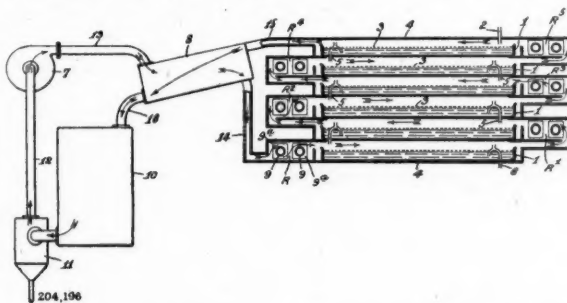
These new products are obtained by condensing a *p*-aryl-quinone of the benzene or naphthalene series, or a halogen derivative, with an *o*-aminoaryl-mercaptan or equivalent such as an *o*-aminoaryl-thiosulphonic acid, an *o*-*o*-dinitro-diaryl-di-sulphide, an *o*-*o*-diamino-diaryl-di-sulphide, the product of the reaction of di-sulphur dichloride on an aromatic amino compound, the transformation product of such a product obtained by the action of water and an alkali. In an alternative, the corresponding *p*-hydroquinone or a halogen derivative and an *o*-aminoaryl-mercaptan or an equivalent, are oxidised together. In an example, a mixture of chloranil with *o*-aminothiophenol, or *o*-aniline thiosulphonic acid, or *o*-*o*-diamino-diphenyl-di-sulphide, is heated with water, spirit, or glacial acetic acid, and the condensation products separated. These dyestuffs dye wool reddish-brown to violet-brown shades in the hydrosulphite vat. Several other examples are given.

207,179. DYEING OF CELLULOSE ACETATES. R. Clavel, Basel Augst, Switzerland. Application date, July 28, 1922.

Cellulose acetate in the form of artificial silk, etc., is dyed with development dyes or ice colours, the development being effected at a temperature between 75° C. and the boiling point. The base and developer baths may be separate or combined. The diazotisation may be affected at or below ordinary temperatures, and easily hydrolysable salts of strong bases of free bases (sodium acetate or caustic soda lye) may be added to the base baths, and acids or acid salts (hydrochloric acid, acetic acid or acid sodium phosphate) may be added to the developing baths. If the bath is combined, one of the above additions alone is added. Protective colloids and/or magnesium chloride may also be added.

204,196. SEPARATION OF ONE OR MORE CONSTITUENTS OF LIQUID MIXTURES, PROCESS FOR. British Cellulose and Chemical Manufacturing Co., Ltd., 8, Waterloo Place, London, S.W.1, and W. Bader, of British Cellulose and Chemical Manufacturing Co., Ltd., Spondon, Derby. Application date, September 6, 1922.

The process is for separating liquid mixtures forming a homogeneous constant boiling mixture or the boiling points of which are very close together. Such mixtures cannot be



separated by fractional distillation without a considerable contamination of one constituent with the other. If such a liquid mixture in a closed vessel is covered with a thin layer of an insoluble liquid of lower density but much higher boiling point, e.g., oil, and if the temperature is kept below the boiling point of the mixture, it is found that the space above the liquid contains the vapours of the mixture. This is due to their solution in the covering liquid, and subsequent evaporation at its surface. If the vapour is continuously removed by a current of air, the composition of the vapour changes, since the speed at which the different constituents can evaporate into the air space depends on their relative solubility in the oil, and not on their boiling points. It is thus possible to distil off a higher boiling constituent, and to leave a lower

boiling constituent behind. The solvent power of the oil should be very small, and less than 1 per cent. is found to be sufficient. The temperature of the mixture is preferably as high as possible without reaching the boiling point, and the current of air which passes over the surface of the liquid is led into a cooling system, where the vapour taken up by it is condensed.

In an example, applied to the treatment of dilute acetic acid of 30 per cent. strength, the acid is admitted through a pipe 2 to the uppermost of a series of superposed flat trays 1 of acid-resisting material. The acid is covered with a thin layer 3 of high boiling petroleum distillate, *e.g.*, a spindle oil, which dissolves about 0.3 per cent. of its weight of acetic acid, but only a very small proportion of water. The trays are slightly spaced from one another, and arranged in a closed-in heat-insulated chamber 4. The acid passes from each tray to the next below through overflow pipes 5, and the overflow is discharged through a pipe 6. Air is supplied by a blower 7 through a heat interchanger 8 to a heater R, which raises its temperature to about 100° C. by means of heating tubes 9. The air passes over the lowest tray, and then through a similar heater R<sup>1</sup>, which restores its temperature to 100° C., and so on over all the trays. The air carrying acetic acid vapour then passes through the heat interchanger 8 to a condenser 10, which removes the acetic acid, while the air is returned through a pipe 12 to the blower 7. In such apparatus it is found that 1,000 sq. ft. of liquid surface yields about 1 ton of distillate in about 24 hours. This distillate is about 60 per cent. strength, and it may be passed again through the apparatus to obtain acetic acid of 80 per cent. strength, and a third time to obtain acid of 92-95 per cent. strength.

204,223. LEAD ARSENATE, PROCESS FOR THE MANUFACTURE OF. I. McDougall, 66 and 68, Port Street, Manchester, and F. Howles, Glenluce, Water Park Road, Broughton Park, Manchester. Application date, October 13, 1922.

Lead arsenate is usually obtained by the reaction of sodium arsenate solution with lead acetate or nitrate solution, but the necessity of using a soluble lead salt increases the cost of the process. In the present invention this is avoided by the direct use of an oxide of lead such as litharge. Disintegrated lead oxide is converted into a colloidal dispersion with water by means of a Plauson or other mill, and the mill is then heated to 80°-100° C. by means of a steam jacket. A solution of arsenic acid is then run into the mill, and lead arsenate is immediately produced. In this process the lead arsenate is obtained in a very finely divided form which is particularly suitable for use as a wash for insecticidal purposes. The product is of better quality than that obtained by the treatment of lead oxide by a mixture of acetic and arsenic acids and the process is quicker and more readily controlled.

204,241 and 204,249. NEW VAT COLOURING MATTERS, MANUFACTURE AND PRODUCTION OF. J. Y. Johnson, London. From Badische Anilin and Soda Fabrik, Ludwigshafen-on-Rhine, Germany. Application date, November 27, 1922, and December 16, 1922.

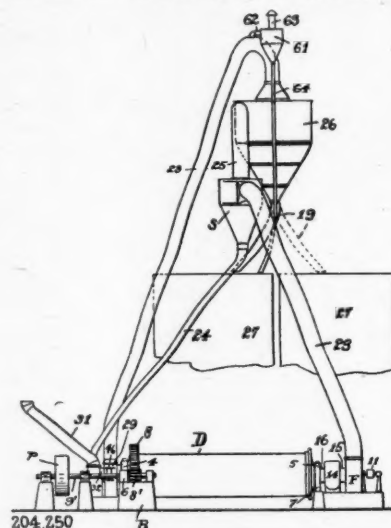
204,241.—New vat colouring matters of the benzanthrone series are obtained by treating dibenzanthrones with hydroxylamine. Examples are given of the treatment of dibenzanthrone with hydroxylamine, hydroxylamine chlorhydrate, or hydroxylamine sulphate. It is known that dibenzanthrone may be transformed into an amino derivative by nitrating, and then reducing yielding a green vat dyestuff. The dyestuffs obtained by the present invention may also be amino derivatives of dibenzanthrone, but they give grey or black shades from a violet coloured hydrosulphite vat after exposure to air. The dyestuffs are practically insoluble in organic solvents, but dissolve in boiling pyridine giving blue solutions with red fluorescence. The dyestuffs are soluble in concentrated sulphuric acid. The hydroxylamine used may be the solution obtained by the electrolytic reduction of nitric acid.

204,249.—These vat colouring matters are obtained by condensing 1-mercapto-2-amino-anthraquinone or a derivative with an aromatic compound containing in its molecule at least two substitutents with reactive carbon atoms, such as carbonyl chloride groups di- or trihalogen methyl groups and the like. The proportions should be one molecular proportion of aromatic compound to two or more molecular proportions of the mercapto-aminoanthraquinone (or 2-aminoanthraquinone and

sulphur). These colouring matters are thiazole derivatives of 2-aminoanthraquinone, and give violet hydrosulphite vats. Examples are given of the condensation of 1-mercapto-2-aminoanthraquinone and (1) terephthaloyl chloride or isophthaloyl chloride, yielding a yellow dyestuff, (2) diphenyl-4:4'-dicarboxylic acid chloride yielding an orange-yellow dyestuff, (3) benzophenone-4:4'-dicarboxylic acid chloride, or benzophenone-2:4'-dicarboxylic acid chloride yielding a yellow dyestuff, (4) mesitylene or trimesinic acid yielding a yellow dyestuff.

204,250. DISINTEGRATING OR PULVERISING APPARATUS. J. E. Kennedy, 120, Broadway, New York. Application date, December 18, 1922.

The apparatus is for disintegrating or pulverising coal, lignite, ore, etc. The grinding mill comprises a horizontal cylindrical drum D supported by hollow trunnions 4, 5, which serve for feeding and delivering the material. In order to



provide sufficient bearing surface for the trunnions without making them sufficiently long to necessitate a conveyor within them, the trunnions are made of large diameter relatively to the drum. The drum is provided with freely moving grinding balls. The highly pulverised material is withdrawn from the drum by a suction fan F connected to the drum through a receptacle 14. The fan delivers through a pipe 23 to a separator S connected by a pipe 25 at the top to a receiver 26 for the pulverised material, which may be delivered by an adjustable shoot 19 to one of two vessels 27. The receiver is connected by a pipe 28 to the charging trunnion of the drum. The coarser material separated in the separator S is also returned to the drum through the pipe 24. The circulation of air through the drum and the separator is regulated by means of adjustable openings to the atmosphere at the inlet and discharge ends of the drum D. The force of the air returning through the pipe 28 may be further reduced, and any pulverised material separated from it, by providing an auxiliary separator 61 having a small inlet pipe 62 from the pipe 28, an air outlet pipe 63, and a pipe 64 to return separated material to the vessel 27.

204,280. DYEING CELLULOSE ESTERS. J. Y. Johnson, London. From Badische Anilin and Soda Fabrik, Ludwigshafen-on Rhine, Germany. Application date, April 5, 1923.

The lack of affinity of cellulose acetate for direct or acid colouring matters is overcome by employing insoluble or difficultly soluble azo colouring matters in the form of their water soluble bisulphite derivatives. In an example, the dye bath may contain 3-5 per cent. of the bisulphite compound of the azo colouring matter aniline-azo-β-naphthol and 1 per cent. of acetic acid, and it may be employed at 70°-75° C.

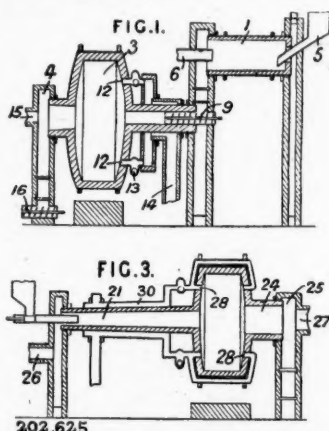
NOTE.—Abstracts of the following specifications which are now accepted, appeared in THE CHEMICAL AGE when they became open to inspection under the International Convention :

192,376 (National Aniline and Chemical Co., Inc.) relating to alkylation and aralkylation of carbazol, see Vol. VIII., p. 377; 195,649 (Farbenfabriken vorm. F. Bayer and Co.) relating to new azo dyes, see Vol. VIII., p. 626; 197,319 (Carbide and Carbon Chemicals Corporation) relating to production of benzaldehyde and benzoic acid, see Vol. IX., p. 46; 197,690 (Soc. d'Etudes Chimiques pour l'Industrie) relating to manufacture of manures containing soluble organic nitrogen from cyanamide, see Vol. IX., p. 69.

### International Specifications not yet Accepted

202,625. GASIFYING COMBUSTIBLE MATERIALS. A. H. Pehrson, 14B, Ostermalmgatan, Stockholm. International Convention date, August 19, 1922.

Coal, shale, peat, or wood is treated in a series of oscillating horizontal or inclined retorts by contact with hot gases, partial combustion, or external heating. The products are withdrawn at each stage of distillation. The material is fed from a hopper 5 to a rotary drier 1, and then by a worm 9 to a rotary retort 3. Hot gas is admitted to the retort through tuyeres 12, and the distillate is drawn off through a chamber



4 and outlet 15. Semi-coke is withdrawn by a worm 16. In a modified apparatus, the feeding conduit 21 is relatively long, and is surrounded by a jacket 30 for preheating the air supply to the retort. The distillate is drawn off through outlets 26, 27, and the residue passes into a chamber 25. Alternatively, the retort may be heated electrically. Iron ore may be added to fix the sulphur content, and a chloride to convert the nitrogen into ammonium chloride.

202,629. SULPHURIC ACID. E. A. Gaillard, 33, Ronda Universidad, Barcelona, Spain. International Convention date, August 17, 1922. Addition to 180,546 (see THE CHEMICAL AGE, Vol. VI, p. 882).

The Glover and Gay Lussac towers are not filled, but the cold acid is sprayed over their inner surfaces to produce a thin film of acid, and also a spray by impact.

202,630 and 202,632. DYES. Durand and Huguenin Akt.-Ges., Basle, Switzerland. (Assignees of M. Bader and C. Sunder, Mulhouse, Haut-Rhin, France. International Convention date, August 21, 1922. Additions to 186,057 (See THE CHEMICAL AGE, Vol. VII, p. 716).

202,630 Specification 186,057 describes the production of ethereal salts of leuco vat-dyes by the action of chlorsulphonic acid on the leuco compounds in presence of a tertiary base. A salt of chlorsulphonic acid is now used, e.g., leuco indigo is treated with sodium chlorsulphonate in presence of dimethylaniline and chlorbenzene, in an atmosphere of carbon dioxide.

202,632. In this invention, fuming sulphuric acid or sulphuric anhydride is used instead of chlorsulphonic acid or chlorsulphonate.

202,631. ORGANIC MERCURY COMPOUNDS. Chemosan Akt.-Ges., 11, Helferstorferstrasse, Vienna. International Convention date, August 17, 1922.

Free hydroxybenzene-sulphonic acids or their homologues are heated with water and mercuric oxide, and the solution neutralised with alkali. Gelatinisation of the solution is prevented by the addition of small quantities of neutral salts such as chlorides, bromides, iodides, and sulphocyanides of alkalies and ammonia.

202,639. DECOLORISING CARBON. R. Adler, Haus Dampf-schiff, Karlsbad, Czecho-Slovakia. International Convention date, August 19, 1922.

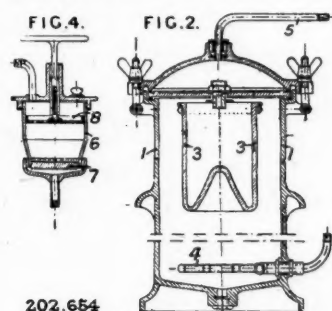
Wood charcoal, bone black, etc., are heated above 500° C. and waste furnace gas, generator gas, or waste lime kiln gas passed over them to increase their porosity. The gas is mixed with a small proportion of oxygen, insufficient to cause oxidation before the gas has penetrated the material.

202,651. CONDENSATION PRODUCTS FROM UREA AND FORMALDEHYDE. O. Neuss, Charlottenburg, Berlin. (Assignee of N. Goldschmidt, Charlottenburg, Berlin.) International Convention date, August 17, 1922.

Urea and formaldehyde are heated with or without condensing media such as acid substances, organic acid substances such as phenol, inorganic non-alkaline substances or mixtures of these. The product is disintegrated and then heated under pressure to obtain waterproof products. Examples are given using sulphuric acid and resorcin as the condensing media.

202,654. PURIFYING LIQUIDS AND GASES. J. N. A. Sauer, 2, Den Texstraat, Amsterdam. International Convention date, August 18, 1922. Addition to 155,610.

Liquid to be purified is supplied through a perforated pipe 4 to a container 1 and intimately mixed with a suspension of an adsorbing agent such as decolorising carbon which



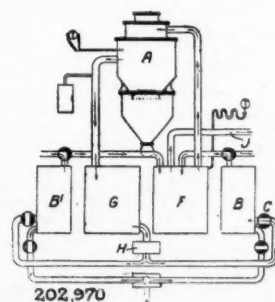
retains the microscopic structure of the vegetable material. The liquid passes through a filter 3 to the outlet 5, and is then passed downwards through adsorbent material compressed between perforated plates 7, 8.

202,660. SYNTHETIC DRUGS. E. Layraud, 25, Boulevard du Temple, Paris. International Convention date, December 31, 1921.

C: C-disubstituted barbituric acids are converted into their salts by treating with mineral alkalies or organic alkalies, particularly piperazine.

202,970. REDUCING OXIDES. G. Constant and A. Bruzac, 13, Boulevard Malesherbes, Paris. International Convention date, August 22, 1922.

Oxides such as iron oxide are reduced by contact with a reducing gas such as producer gas, and the resulting gas is



then treated with carbon to reconvert the carbon dioxide into monoxide, so that the gas may be used again. Gas from the producer B is passed through the reducing chamber A containing the oxide, and the spent gas then passes through a cooler G, blower H, and valve C to the producer B. A gasholder F is provided to ensure continuity of supply of gas



during the blowing process in the producer. An additional producer B may be used to ensure continuity.

- 202,975. AROMATIC SULPHONIC ACIDS. Rheinische Kampfer-Fabrik Ges., 2, Dusseldorferstrasse, Oberkassel, Dusseldorf, Germany. International Convention date, August 23, 1922.

Aromatic sulphonic acids with halogens in the aromatic nucleus are treated with hydrogen to replace the halogen atoms, in the presence of a catalyst such as nickel, cobalt, copper, platinum or palladium, which may be in colloidal form or on a carrier such as kieselguhr or calcium carbonate. The aromatic nucleus in the sulphonic acid may be benzene, naphthalene, anthracene, etc. Examples are given of the treatment of *p*-bromobenzene sulphonic acid, 2-chlor-*p*-cymene-3-sulphonic acid, and 2-brom-*p*-cymene-3-sulphonic acid with hydrogen at 10-30 atmospheres pressure, using a nickel catalyst.

- 202,984. DYEING AND PRINTING. Soc. of Chemical Industry in Basle, Switzerland. International Convention date, August 23, 1922.

The insoluble azo dyestuffs from arylides of 2:3-oxynaphthoic acid and diazo compounds of aryl- or aralkyl-ethers of *o*-aminophenol or a nuclear substitution product, are formed on the fibre by the usual methods, giving fast red shades. Cotton may be impregnated with 2:3-oxynaphthoic anilide or *p*-toluidide and treated with diazotised 2-amino-4-chlorbenzene-1-phenylether neutralised with calcium carbonate.

- 202,985. PERCARBONATES, PERBORATES, AND OTHER PERSALTS. F. Noll, Benrath, Dusseldorf, Germany. International Convention date, August 28, 1922.

Sodium carbonate or hydrate, or borax, which are to be converted into persalts, are first treated for several days with alkali monosilicates or disilicates to remove any metal compound which might have a catalytic effect on the persalt, causing liberation of oxygen. The persalts obtained after this preliminary treatment are stable. In an example a solution of borax and caustic soda is treated with sodium disilicate for 2-3 days at 30°-35° C. The solution is filtered, cooled to 0°-5° C., and treated with hydrogen peroxide to obtain the perborate.

#### LATEST NOTIFICATIONS.

- 205,463. Process for the manufacture of useful articles from waste scrap of cellulose derivatives. Schmidt, Dr. F. October 13, 1922.  
205,477. Process for the synthetic production of ammonia. Norsk Hydro-Electrisk Kvælotofaktieselskab. October 12, 1922.  
205,487. Mixing of materials with rubber latex. Hopkinson, E. October 16, 1922.  
205,502. Manufacture of condensation products of the anthraquinone series. Farbwerke vorm. Meister, Lucius, and Brüning. October 12, 1922.  
205,503. Manufacture of mono-azo dyestuffs. Farbwerke vorm. Meister, Lucius, and Brüning. October 12, 1922.

#### Specifications Accepted, with Date of Application

- 177,809, 177,810, 203,346, and 203,347. Cellulose derivatives, Manufacture of. L. Lilienfeld. April 2, 1921.  
182,802. Melting and reducing furnaces, Method of and apparatus for operating. A. Ziegler. July 5, 1921.  
184,462. Waterproofing cellulose or carbohydrates of the cellulose group. F. Moeller. August 12, 1921.  
189,416. Cellulose esters, Solutions of. Nitrogen Corporation. November 21, 1921.  
190,148. Capillary process of transferring liquids applicable to chemical reactions, photography, dyeing, tannery and the like. L. Lumière. December 7, 1921.  
190,174. Oil and fatty bodies, Process for recovering the solvents in the extraction of. Soc. Generale d'Evaporation Procèdes Prache et Bouillon. December 12, 1921.  
199,401. Dioxyperylene, Reduction of. H. Pereira. June 19, 1922.  
199,720. Dinitro-*p*-erylene-quinone, Process of manufacturing. H. Pereira. June 20, 1922.  
204,754. Artificial resins and oleoresins, Process for the preparation of. H. Wuyts. June 29, 1922.  
204,757. Vulcanisation of rubber and similar materials. Dunlop Rubber Co., Ltd., D. F. Twiss, and F. Thomas. June 30, 1922.  
204,775. Alcohol from mashes or similar water-containing alcoholic mixtures, Separation by distillation of. H. F. Harris. July 5, 1922.  
204,886. Chromium oxide from chrome iron ore, Process for the production. A. L. Mond. (Chemische Fabrik Griesheim-Elektron.) September 22, 1922.

- 204,894. Crushing apparatus. J. E. Kennedy. October 2, 1922.  
204,902. Vulcanisation of rubber. H. Skellon, T. H. Roberts, and H. B. R. Clarke. October 6, 1922.  
204,909. Gas producing methods and apparatus therefor. E. Berg. October 10, 1922.  
204,976. Coal tar, Treatment of. W. E. W. Richards and Siluminit Insulator Co., Ltd. December 19, 1922.

#### Applications for Patents

- Baddiley, J., British Dyestuffs Corporation, Ltd, Hill, J., Lawrie, L., Shepherdson, A. and Swann, H. Dyeing acetyl cellulose, etc. 26158. October 19.  
Chadwick, J. W. Treating hydrocarbon vapours. 26015. October 18.  
Duplan, F. Furnaces for distillation and carbonization. 25854. October 16.  
Etablissements Poulenc Frères, and Oechslin, C. Manufacture of substituted products of an aliphatic arsinic acid. 26163. October 19. (France, October 28, 1922.)  
Klein, E. Manufacture of alcohol and yeast. 26014. October 18. (Austria, August 29, 1922.)  
Lantz, R., Soc. Anon. des Matières Colorantes et Produits Chimiques de Saint-Denis, and Wahl, A. Manufacture of naphthaquinone derivatives. 26037. October 18. (France, October 30, 1922.)  
Lantz, R., Soc. Anon. des Matières Colorantes et Produits Chimiques de Saint-Denis and Wahl, A. Dyestuffs. 26154. October 19. (France, October 31, 1922.)  
Mandleberg & Co., Ltd., J. and Rothband, H. L. Artificial silk. 25934. October 17.  
Oberlander, O. Manufacture of material from cellulose compounds. 26051. October 18.  
Pereira, H. Manufacture of perylene vat dye. 25665. October 15. (Austria, October 28, 1922.)  
Pereira, H. Manufacture of 3.10. perylene quinone. 25666. October 15. (Austria, October 28, 1922.)  
Schofield, H. Method of atomizing and oxidizing oils. 25732. October 16.  
Soc. Anon. Le Carbone. Process for rendering porous electrodes impermeable to liquids. 26140. October 19. (France, February 21.)  
Soc. des Produits Azotes. Isolation of urea and its compounds. 26164. October 19. (France, Nov. 3, 1922.)  
Soc. L'Oxyhydrique Française. Manufacture of hydrogen. 25936. October 17. (France, November 7, 1922.)  
Texas Gulf Sulphur Co. Burning of sulphur. 25698. October 15. (United States, February 21.)

#### Physics in the Cotton Industry

"THE Physicist in the Textile Industry" was the subject of a lecture given on Monday evening at the Institution of Electrical Engineers by Dr. A. E. Oxley, physicist to the British Cotton Industries Research Association. The lecture was the fifth of a series on "Physics in Industry" which is being given under the auspices of the Institute of Physics. Sir Charles Parsons, who has just succeeded Sir J. J. Thomson as president of the Institute, was in the chair.

Dr. Oxley said it had been one of the weaknesses of the cotton industry that it had not used to the full the immense power bestowed on this generation by scientific discovery. The textile industry offered an almost entirely unexplored field for the research physicist and problems sufficient for a brigade of physicists. There was no industry so much in need of co-operation with the physicist as those of the textile group. Producing a specimen of cotton pod grown under glass in Manchester, Dr. Oxley explained the manufacturing processes it underwent, and in offering illustrations of the assistance of scientific method he said that one of the most important qualities of spun thread was its evenness or regularity. Hitherto the spinner had used the primitive method of taking a thread and winding it on a card, and the test of regularity was that of looking at the patchiness of the yarn. Recently they had been taking photographs of the regularity and tracing variation under high magnification. Another useful device had been provided in the oscillating stresses machine. It had been found that any thread could be broken by sufficient oscillation. "I think there is no machine of the cotton trade," concluded Dr. Oxley, "which cannot be improved, and if you think of the enormous number of processes through which the cotton has to pass and the labour entailed in handling the material you realise that if one or two of these processes could be eliminated it would mean millions and millions to England." It was by a combination of efforts between scientists and the operatives that a trade of such vast importance to England and the world would remain with England.

# Market Report and Current Prices

*Our Market Report and Current Prices are exclusive to THE CHEMICAL AGE, and, being independently prepared with absolute impartiality by Messrs. R. W. Greeff & Co., Ltd., and Messrs. Chas. Page & Co., Ltd., may be accepted as authoritative. The prices given apply to fair quantities delivered ex wharf or works, except where otherwise stated. The current prices are given mainly as a guide to works managers, chemists, and chemical engineers; those interested in close variations in prices should study the market report.*

London, October 25, 1923.

THE past week has seen a fairly substantial turnover in most chemicals and the outlook is better. Anxiety is expressed in a number of directions as to the possibility of a distinct shortage of supply of many articles due to the progress of events on the Continent. The effect of the elimination of Germany as a competitor is in many cases becoming more and more evident, and it is quite probable that for many articles a different standard of values will shortly obtain.

The export market is without special feature.

## General Chemicals

ACETONE remains a steady market with price unchanged.  
ACID ACETIC is an active market and stocks are scarce.  
ACID CITRIC remains uninteresting.  
ACID LACTIC is scarce. Price seems likely to go higher.  
ACID OXALIC is in fair demand, and in view of the German situation higher prices are looked for.  
ARSENIC is unchanged.  
BARIUM CHLORIDE is a slow market; the tendency is in buyers' favour.  
FORMALDEHYDE.—A satisfactory turnover is reported. Spot supplies are scarce and command a premium.  
LEAD ACETATE is dearer and in better demand.  
LEAD NITRITE is unchanged.  
LIME ACETATE is scarce and firm.  
LITHOPONE.—A better business is reported. Prices are very firm.  
CARBONATE and CAUSTIC POTASH are unchanged.  
POTASSIUM PRUSSATE is again lower in price.  
SODA ACETATE is in good demand and scarce. The price seems likely to advance.  
SODIUM HYPOSULPHITE is unchanged.  
SODIUM PRUSSATE seems to have turned the corner, and price is higher.  
SODIUM SULPHIDE is in good demand, and price is firm.  
ZINC SALTS are unchanged.

## Pharmaceutical Chemicals

ACETYL SALICYLIC ACID is firm, and has been in steady demand at last prices.  
ACETANILID is firm and in restricted supply.  
AMIDOPYRIN is firmer.  
BROMIDES are slowly recovering from their recent low level, an improved business being reported.  
GUAIACOL CARBONATE is firm. The leading manufacturers have apparently sold their production well ahead, and decline to entertain fresh orders at present time.  
HEXAMINE is firm; stocks are becoming small, considerable quantities having recently passed into consumption.  
PHENOLPHTHALEIN has advanced.  
SODA BENZOATE is firm, and in demand for export.  
SODA SALICYLATE has been selling freely.  
SULPHONAL has advanced.  
VANILLIN is quiet, price unchanged.

## Coal Tar Intermediates

Business continues to progress on quiet, steady lines with no features of outstanding interest to report.  
ALPHA NAPHTHOL is still in short supply and fair interest has been shown on export account.  
ALPHA NAPHTHYLAMINE is without change in price.  
ANILINE OIL continues to pass into home consumption without change in price, but some good export inquiries have been received.  
ANILINE SALT has been the object of some enquiry.  
DIPHENYLAMINE is in demand on home account and the price is very firm.  
H ACID.—A few small orders are reported.  
NITRO BENZOL is without special feature.  
PARAPHENYLENEDIAMINE is in demand at recent values.  
RESORCINE is in request and spot supplies seem to be short.

## Coal Tar Products

The market in coal tar products remains fairly steady.  
90% BENZOL remains unchanged at 1s. 4d. per gallon on rails.  
PURE BENZOL has no great demand, and is worth about 1s. 7d. to 1s. 8d. per gallon on rails.  
CREOSOTE OIL is firm at 8½d. to 8¾d. per gallon on rails in the North, while in the South the price is 9¼d. to 9½d. per gallon.  
CRESYLIC ACID has a limited inquiry, the pale quality, 97/99%, being worth about 1s. 10d. to 2s. per gal. on rails, while the dark quality, 95/97%, is quoted at 1s. 7d. to 1s. 8d. per gal. on rails.  
SOLVENT NAPHTHA remains steady at 1s. per gal. on rails, the principal inquiry being for export, which has somewhat relieved the position.  
HEAVY NAPHTHA is quiet, and is worth 1s. 1d. to 1s. 2d. per gal. on rails.  
NAPHTHALENES are, if anything, slightly weaker, although the values remain unchanged at £6 10s. to £7 per ton for the low-grade quality, the 74/76 quality being quoted at £7 10s. to £8 per ton, while 76/78 is worth from £8 10s. to £9 per ton on rails.  
PITCH continues to strengthen in spite of the demand having eased slightly during the past few days. To-day's quotations are:—140s. to 145s. per ton, f.o.b., London; 137s. 6d. to 140s. per ton, f.o.b. East Coast; 135s. to 140s. per ton, f.o.b. West Coast.

## Sulphate of Ammonia

SULPHATE OF AMMONIA.—The demand is improving and prices remain steady.

[Current Market Prices on following pages.]

## Chemical Trade Inquiries

The following inquiries, abstracted from the "Board of Trade Journal," have been received at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W.1. British firms may obtain the names and addresses of the inquirers by applying to the Department (quoting the reference number and country), except where otherwise stated.

HEAVY CHEMICALS FOR AUSTRALIA.—An Australian manufacturers' agent, at present in London, wishes to be put into touch with manufacturers of raw materials, heavy chemicals, sheetings, soft goods generally or other lines suitable to the Australian trade. Letters should be addressed in the first instance to the Official Secretary, Commercial Branch, Australia House, Strand, London, W.C.2, quoting reference No. 412/7/1/1/167.

LUBRICATING OILS AND GREASES.—A commission agent in Christiania desires to secure the representation for Norway of British exporters of lubricating oils and grease and rubber soles and heels.

OLIVE OIL SOAP AND OLIVE OIL.—A firm of agents resident in Auckland, New Zealand, desire to obtain the representation of a British exporter of olive oil soap, shaving soap and olive oil.

PAINTS, VARNISHES, COLOURS.—An agent resident in Larnaca, Cyprus, desires to secure the representation of British manufacturers of the above lines on a commission basis. A United Kingdom reference is supplied.

VARIOUS CHEMICALS.—A commission agent of Barcelona, Spain, is desirous of securing the representation of British manufacturers of sulphate of ammonia, sulphate of copper and superphosphates.

DRUGS AND CHEMICALS.—A commission agent of Guatemala City is desirous of securing the representation of British firms manufacturing drugs and chemicals, perfumery, surgical and dental appliances and supplies.

## Tariff Changes

BRITISH GUIANA.—The import duty on refined petroleum (flash point over 85° F.) has been increased, the rate now being 25 cents per gallon under the British preferential tariff and 50 cents per gallon under the general tariff.

TUNIS.—Anthraquinone may now be imported duty free.

## Current Market Prices

## General Chemicals

	Per	£	s.	d.	Per	£	s.	d.
Acetic anhydride, 90-95%.....	lb.	0	1	4	to	0	1	5
Acetone oil.....	ton	80	0	0	to	85	0	0
Acetone, pure.....	ton	127	10	0	to	130	0	0
Acid, Acetic, glacial, 99-100%.....	ton	73	0	0	to	74	0	0
Acetic, 80% pure.....	ton	49	0	0	to	50	0	0
Acetic, 40% pure.....	ton	25	0	0	to	26	0	0
Arsenic, liquid, 2000 s.g.....	ton	85	0	0	to	88	0	0
Boric, commercial.....	ton	48	0	0	to	52	0	0
Carbolic, cryst. 39-40%.....	lb.	0	1	1½	to	0	1	2½
Citric.....	lb.	0	1	5	to	0	1	5½
Formic, 80%.....	ton	50	0	0	to	51	0	0
Hydrofluoric.....	lb.	0	0	7½	to	0	0	8½
Lactic, 50 vol.....	ton	39	0	0	to	40	0	0
Lactic, 60 vol.....	ton	44	0	0	to	46	0	0
Nitric, 80 Tw.....	ton	26	0	0	to	27	0	0
Oxalic.....	lb.	0	0	6½	to	0	0	6½
Phosphoric, 1.5.....	ton	35	0	0	to	38	0	0
Pyrogallol, cryst.....	lb.	0	5	9	to	0	6	0
Salicylic, technical.....	lb.	0	1	9	to	0	2	0
Sulphuric, 92-93%.....	ton	6	0	0	to	7	0	0
Tannic, commercial.....	lb.	0	2	3	to	0	2	9
Tartaric.....	lb.	0	1	1½	to	0	1	2
Alum, lump.....	ton	12	10	0	to	13	0	0
Chrome.....	ton	28	0	0	to	29	0	0
Alumino ferric.....	ton	7	0	0	to	7	5	0
Aluminium, sulphate, 14-15%.....	ton	8	10	0	to	9	0	0
Sulphate, 17-18%.....	ton	10	10	0	to	11	0	0
Ammonia, anhydrous.....	lb.	0	1	6	to	0	1	8
880.....	ton	32	0	0	to	34	0	0
920.....	ton	22	0	0	to	24	0	0
Carbonate.....	ton	30	0	0	to	32	0	0
Chloride.....	ton	50	0	0	to	55	0	0
Muriate (galvanisers).....	ton	35	0	0	to	37	10	0
Nitrate (pure).....	ton	35	0	0	to	40	0	0
Phosphate.....	ton	63	0	0	to	65	0	0
Sulphocyanide, commercial 90% lb.....	0	1	1	0	to	0	1	3
Amyl acetate, technical.....	ton	280	0	0	to	300	0	0
Arsenic, white powdered.....	ton	65	0	0	to	68	0	0
Barium, carbonate, Witherite.....	ton	5	0	0	to	6	0	0
Carbonate, Precip.....	ton	15	0	0	to	16	0	0
Chlorate.....	ton	65	0	0	to	70	0	0
Chloride.....	ton	15	10	0	to	16	0	0
Nitrate.....	ton	33	0	0	to	35	0	0
Sulphate, blanc fixe, dry.....	ton	20	10	0	to	21	0	0
Sulphate, blanc fixe, pulp.....	ton	10	5	0	to	10	10	0
Sulphocyanide, 95%.....	lb.	0	0	11	to	0	1	0
Bleaching powder, 35-37%.....	ton	10	7	6	to	10	17	6
Borax crystals, commercial.....	ton	25	0	0	to	—	—	—
Calcium acetate, Brown.....	ton	13	0	0	to	14	0	0
Grey.....	ton	22	0	0	to	23	0	0
Carbide.....	ton	13	0	0	to	13	10	0
Chloride.....	ton	5	15	0	to	6	0	0
Carbon bisulphide.....	ton	35	0	0	to	40	0	0
Casein technical.....	ton	80	0	0	to	90	0	0
Cerium oxalate.....	lb.	0	3	0	to	0	3	6
Chromium acetate.....	lb.	0	1	1	to	0	1	3
Cobalt acetate.....	lb.	0	6	0	to	0	6	6
Oxide, black.....	lb.	0	9	6	to	0	10	0
Copper chloride.....	lb.	0	1	1	to	0	1	2
Sulphate.....	ton	25	10	0	to	26	0	0
Cream Tartar, 98-100%.....	ton	86	0	0	to	88	0	0
Epsom salts (see Magnesium sulphate)								
Formaldehyde, 40% vol.....	ton	70	0	0	to	72	0	0
Formosul (Rongalite).....	lb.	0	2	1	to	0	2	2
Glauber salts, commercial.....	ton	4	0	0	to	4	10	0
Glycerin crude.....	ton	65	0	0	to	67	10	0
Hydrogen peroxide, 12 vols.....	gal	0	2	0	to	0	2	1
Iron perchloride.....	ton	18	0	0	to	20	0	0
Sulphate (Copperas).....	ton	3	10	0	to	4	0	0
Lead acetate, white.....	ton	41	0	0	to	42	0	0
Carbonate (White Lead).....	ton	43	0	0	to	45	0	0
Nitrate.....	ton	44	10	0	to	45	0	0
Litharge.....	ton	37	0	0	to	39	0	0
Lithophone, 30%.....	ton	22	10	0	to	23	0	0
Magnesium chloride.....	ton	3	10	0	to	3	15	0
Carbonate, light.....	cwt.	2	10	0	to	2	15	0
Sulphate (Epsom salts commercial)								
Sulphate (Druggists').....	ton	5	15	0	to	6	0	0
Manganese Borate, commercial.....	ton	65	0	0	to	75	0	0
Sulphate.....	ton	45	0	0	to	50	0	0
Methyl acetone.....	ton	82	0	0	to	85	0	0
Alcohol, 1% acetone.....	ton	105	0	0	to	110	0	0
Nickel sulphate, single salt.....	ton	37	0	0	to	38	0	0
Ammonium sulphate, double salt ton		37	0	0	to	38	0	0

	Per	£	s.	d.	Per	£	s.	d.
Potash, Caustic.....	ton	30	0	0	to	32	0	0
Potassium bichromate.....	lb.	0	0	5½	to	0	0	6
Carbonate, 90%.....	ton	30	0	0	to	31	0	0
Chloride, 80%.....	ton	9	0	0	to	10	0	0
Chlorate.....	lb.	0	0	3½	to	—	—	—
Metabisulphite, 50-52%.....	ton	65	0	0	to	70	0	0
Nitrate, refined.....	ton	38	0	0	to	40	0	0
Permanganate.....	lb.	0	0	10	to	0	0	10½
Prussiate, red.....	lb.	0	2	10	to	0	3	0
Prussiate, yellow.....	lb.	0	0	10½	to	0	0	11
Sulphate, 90%.....	ton	10	0	0	to	10	10	0
Salammuniac, firsts.....	cwt.	3	3	0	to	—	—	—
Seconds.....	cwt.	3	0	0	to	—	—	—
Sodium acetate.....	ton	25	0	0	to	25	10	0
Arsenate, 45%.....	ton	45	0	0	to	48	0	0
Bicarbonate.....	ton	10	10	0	to	11	0	0
Bichromate.....	lb.	0	0	4½	to	0	0	4½
Bisulphite, 60-62%.....	ton	21	0	0	to	23	0	0
Chlorate.....	lb.	0	0	3	to	0	0	3½
Caustic, 70%.....	ton	17	10	0	to	18	0	0
Caustic, 76%.....	ton	18	10	0	to	19	0	0
Hydrosulphite, powder.....	lb.	0	1	5	to	0	1	6
Hyposulphite, commercial.....	ton	10	10	0	to	11	0	0
Nitrite, 96-98%.....	ton	27	10	0	to	28	0	0
Phosphate, crystal.....	ton	16	0	0	to	16	10	0
Perborate.....	lb.	0	0	11	to	0	1	0
Prussiate.....	lb.	0	0	6	to	0	0	6½
Sulphide, crystals.....	ton	8	10	0	to	9	0	0
Sulphide, solid, 60-62 %.....	ton	14	10	0	to	15	10	0
Sulphite, cryst.....	ton	11	10	0	to	12	0	0
Strontium carbonate.....	ton	50	0	0	to	55	0	0
Nitrate.....	ton	50	0	0	to	55	0	0
Sulphate, white.....	ton	6	10	0	to	7	10	0
Sulphur chloride.....	ton	25	0	0	to	27	10	0
Flowers.....	ton	11	0	0	to	11	10	0
Roll.....	ton	9	15	0	to	10	10	0
Tartar emetic.....	lb.	0	0	11½	to	0	1	0
Tin perchloride, 33%.....	lb.	0	1	1	to	0	1	2
Perchloride, solid.....	lb.	0	1	3	to	0	1	4
Protochloride (tin crystals).....	lb.	0	1	4	to	0	1	5
Zinc chloride 102° Tw.....	ton	20	0	0	to	21	0	0
Chloride, solid, 96-98%.....	ton	25	0	0	to	30	0	0
Oxide, 99%.....	ton	42	0	0	to	45	0	0
Dust, 90%.....	ton	50	0	0	to	55	0	0
Sulphate.....	ton	15	0	0	to	16	0	0

## Pharmaceutical Chemicals

Acetyl salicylic acid.....	lb.	0	3	4	to	0	3	8
Acetanilid.....	lb.	0	1	10	to	0	2	0
Acid, Gallic, pure.....	lb.	0	3	0	to	0	3	3
Lactic, 1.21.....	lb.	0	2	6	to	0	2	9
Salicylic, B.P.....	lb.	0	2	2	to	0	2	4
Tannic, lewiss.....	lb.	0	3	2	to	0	2	4
Amidol.....	lb.	0	7	9	to	0	8	3
Amidopyrin.....	lb.	0	13	0	to	0	14	0
Ammon ichthosulphonate.....	lb.	0	1	10	to	0	2	0
Barbitone.....	lb.	0	16	6	to	0	17	0
Beta naphthol resublimed.....	lb.	0	2	0	to	0	2	3
Bromide of ammonia.....	lb.	0	0	8	to	0	0	9
Potash.....	lb.	0	0	6½	to	0	0	7
Soda.....	lb.	0	0	7½	to	0	0	8
Caffeine, pure.....	lb.	0	10	9	to	0	11	0½
Calcium glycerophosphate.....	lb.	0	5	9	to	0	6	0½
Lactate.....	lb.	0	1	10	to	0	2	0
Calomel.....	lb.	0	3	9	to	0	4	0
Chloral hydrate.....	lb.	0	4	0	to	0	4	3
Cocaine alkaloid.....	oz.	0	19	6	to	1	0	0
Hydrochloride.....	oz.	0	16	9	to	0	17	3
Corrosive sublimate.....	lb.	0	3	3	to	0	3	6
Eucalyptus oil, B.P. (70-75% eucalyptol).....	lb.	0	2	8	to	0	2	10
B.P. (75-80% eucalyptol).....	lb.	0	2	9	to	0	2	11
Guaiacol carbonate.....	lb.	0	11	0	to	0	11	6
Liquid.....	lb.	0	8	9	to	0	9	3
Pure crystals.....	lb.	0	9	3	to	0	9	9
Hexamine.....	lb.	0	4	0	to	0	4	3
Hydroquinone.....	lb.	0	3	6	to	0	4	0
Lanoline anhydrous.....	lb.	0	0	7	to	0	0	7½
Lecithin ex ovo.....	lb.	0	17	6	to	0	19	0
Lithi carbonate.....	lb.	0	9	6	to	0	10	0
Methyl salicylate.....	lb.	0	2	8	to	0	3	2
Metol.....	lb.	0	9	0	to	0	10	0
Milk sugar.....	cwt.	4	2	6	to	4	10	0
Paraldehyde.....	lb.	0	1	5	to	0	1	6
Phenacetin.....	lb.	0	6	3	to	0	6	9
Phenazone.....	lb.	0	8	3	to	0	8	6
Phenolphthalein.....	lb.	0	7	0	to	0	7	3
Potassium sulpho guaiacolate.....	lb.	0	5	0	to	0	5	3
Quinine sulphate, B.P.....	oz.	0	2	3	to	—	—	—



	Per	£	s.	d.	£	s.	d.
Resorcin, medicinal.....lb.	0	5	6	to	0	5	9
Salicylate of soda powder.....lb.	0	2	8	to	0	2	10
Crystals.....lb.	0	2	9	to	0	3	0
Salol.....lb.	0	3	6	to	0	3	9
Soda Benzoate.....lb.	0	2	6	to	0	2	9
Sulphonol.....lb.	0	17	0	to	0	18	0
Terpene hydrate.....lb.	0	1	9	to	0	2	0
Theobromine, pure.....lb.	0	11	0	to	0	11	6
Soda salicylate.....lb.	0	8	6	to	0	9	0
Vanillin.....lb.	1	3	0	to	1	4	0

## Coal Tar Intermediates, &amp;c.

Alphanaphthol, crude.....lb.	0	2	0	to	0	2	3
Refined.....lb.	0	2	6	to	0	2	9
Alphanaphthylamine.....lb.	0	1	6½	to	0	1	7
Aniline oil, drums extra.....lb.	0	0	9	to	0	0	9½
Salts.....lb.	0	0	9½	to	0	0	10
Anthracene, 40-50%.....unit	0	0	8½	to	0	0	9
Benzaldehyde (free of chlorine).....lb.	0	2	6	to	0	2	9
Benzidine, base.....lb.	0	4	9	to	0	5	0
Sulphate.....lb.	0	3	9	to	0	4	0
Benzoic acid.....lb.	0	2	0	to	0	2	3
Benzyl chloride, technical.....lb.	0	2	0	to	0	2	3
Betanaphthol.....lb.	0	1	1	to	0	1	2
Betanaphthylamine, technical.....lb.	0	4	0	to	0	4	3
Croceine Acid, 100% basis.....lb.	0	3	3	to	0	3	6
Dichlorobenzol.....lb.	0	0	9	to	0	0	10
Diethylaniline.....lb.	0	4	6	to	0	4	9
Dinitrobenzol.....lb.	0	1	1	to	0	1	2
Dinitrochlorbenzol.....lb.	0	0	11	to	0	0	10
Dinitronaphthalene.....lb.	0	1	4	to	0	1	5
Dinitrotoluol.....lb.	0	1	4	to	0	1	5
Dinitrophenol.....lb.	0	1	6	to	0	1	7
Dimethylaniline.....lb.	0	2	9	to	0	3	0
Diphenylamine.....lb.	0	3	6	to	0	3	9
H-Acid.....lb.	0	4	9	to	0	5	0
Metaphenylenediamine.....lb.	0	4	0	to	0	4	3
Monochlorbenzol.....lb.	0	0	10	to	0	0	10
Metanilic Acid.....lb.	0	5	9	to	0	6	0
Metatoluylenediamine.....lb.	0	4	0	to	0	4	3
Monosulphonic Acid (2.7).....lb.	0	8	6	to	0	9	6
Naphthionic acid, crude.....lb.	0	2	6	to	0	2	8
Naphthionate of Soda.....lb.	0	2	6	to	0	2	8
Naphthylamin-di-sulphonic-acid.....lb.	0	4	0	to	0	4	3
Nevill: Winther Acid.....lb.	0	7	3	to	0	7	9
Nitrobenzol.....lb.	0	0	7	to	0	0	8
Nitronaphthalene.....lb.	0	0	11½	to	0	0	10
Nitrotoluol.....lb.	0	0	8	to	0	0	9
Orthoamidophenol base.....lb.	0	12	0	to	0	12	6
Orthodichlorbenzol.....lb.	0	1	0	to	0	1	1
Orthotoluidine.....lb.	0	0	10	to	0	0	11
Orthonitrotoluol.....lb.	0	0	3	to	0	0	4
Para-amidophenol, base.....lb.	0	8	6	to	0	9	0
Hydrochlor.....lb.	0	7	6	to	0	8	0
Paradichlorbenzol.....lb.	0	0	9	to	0	0	10
Paranitraniline.....lb.	0	2	7	to	0	2	9
Paranitrophenol.....lb.	0	2	3	to	0	2	6
Paranitrotoluol.....lb.	0	2	9	to	0	3	0
Paraphenylenediamine, distilled.....lb.	0	12	0	to	0	12	6
Paratoluidine.....lb.	0	5	6	to	0	5	9
Phthalic anhydride.....lb.	0	2	6	to	0	2	9
Resorcin technical.....lb.	0	4	0	to	0	4	3
Sulphanilic acid, crude.....lb.	0	0	10	to	0	0	11
Tolidine, base.....lb.	0	7	3	to	0	7	9
Mixture.....lb.	0	2	6	to	0	2	9

	£	s.	d.
Orange sweet (Sicilian) .....	0	10	6
(West Indian) .....	0	9	0
Palmarosa .....	1	3	0
Peppermint (American) .....	0	15	0
Mint (dementholised Japanese) .....	0	12	0
Patchouli .....	1	10	0
Otto of Rose .....	1	15	0
per oz.			
Rosemary .....	0	1	7
Sandalwood .....	1	6	0
Sassafras .....	0	7	0
Thyme .....	2/6	to	0

## SYNTHETICS.

Benzyl acetate.....per lb.	0	3	0
Benzoate.....	0	3	0
Citral.....	0	10	0
Coumarine.....	0	18	6
Heliotropine.....	0	8	0
Ionone.....	1	2	0
Linalyl acetate.....	1	5	0
Methyl salicylate.....	0	2	9
Musk xylol.....	0	11	0
Terpeniol.....	0	3	0

## Chile Nitrate Report

In their fortnightly review of the nitrate position, Aikman (London), Ltd., state: The market has been firm but quiet throughout the fortnight, with business at a minimum, the wide fluctuations in Continental currencies having for the time being proved a deterrent to consuming buyers contracting ahead. More inquiry is reported at the close. The f.o.b. market has also been quiet pending the absorption of the large quantities bought in September, and no new sales have been made by the Producers' Association, the total for shipment after July 1, 1923, thus remaining at 1,280,000 tons. Adding to this the visible supply at June 30, 1923, unshipped sales made for June delivery, and the estimated production of the Lautaro and American companies for shipment up to April 30, 1924, the total supplies so far arranged for consumption during the current nitrate year amount to 1,760,000 tons, against a quantity of about 1,400,000 tons arranged at this date last year (of which 950,000 tons represented sales by the association). A large proportion of the increased quantity so far arranged for the coming season represents increased sales already made to consuming dealers, which augurs well for next season's consumption.

The European deliveries for first half October amount to about 27,000 tons, against 20,000 tons last year. Stocks at 15th inst. were about 210,000 tons and afloat 175,000 tons, against 190,000 tons and 122,000 tons respectively at October 15, 1922. The strike at Junin has ended, but that at Iquique still continues, although shipments are reported to have again commenced, with the help of outside labour. Strikes are reported to have broken out at Junin and Pisagua. A cable from the association announces that a serious shortage in stocks on the pampa in certain oficinas was disclosed when the nitrate was finally shipped, and, as a result, stocks in Chile at June 30, 1923, are rectified from 1,023,000 to 997,000 tons, at July 31, from 986,000 to 960,000, August 31 from 939,000, and at September 30 from 953,000 to 927,000 tons.

## Essential Oils and Synthetics

ESSENTIAL OILS.	£	s.	d.
Anise.....c.i.f. 1/9 spot	0	1	10
Bay.....	0	12	0
Bergamot.....dearer	0	13	6
Cajapat.....	0	3	3
Camphor, white.....per cwt.	4	0	0
Brown.....	3	15	0
Cassia.....c.i.f. 10/6 spot	0	11	0
Cedarwood.....	0	1	4½
Citronella (Ceylon).....nominal & scarce on spot c.i.f. 3/6 spot	0	4	2
(Java).....dearer c.i.f. 4/1 spot	0	4	3
Clove.....dearer	0	8	6
Eucalyptus.....very firm	0	2	6
Geranium Bourbon.....firm	1	15	0
Lavender.....	1	4	0
Lavender spike.....dearer and firm	0	3	0
Lemon.....	0	2	11
Lemongrass.....per oz.	0	0	2½
Lime (distilled).....	0	4	0

## Methylated Spirit Prices Advanced

THE METHYLATED CO., LTD., of Kinnaird House, Pall Mall East, London, S.W.1, announce that from Monday last, October 22, their prices will be as follows:—

In One Delivery.	Industrial Methylated Spirit.	Mineralised Methylated Spirit (Coloured Violet).
	61 o.p.	64 o.p.
100 gallons and upwards	3s. 0d...3s. 1d.	4s. 1d...4s. 2d.
30 gallons and under 100	3s. 2d...3s. 3d.	4s. 3d...4s. 4d.
10 gallons and under 30	3s. 4d...3s. 5d.	4s. 5d...4s. 6d.
Methylated resin finish 2d. per gallon extra and methylated shellac finish 8d. per gallon extra over the prices quoted for industrial methylated spirit.		

In Northern Ireland (Ulster) the prices will be 4d. per gallon higher and in the Free State 10d. per gallon higher than those for England and Scotland.

## Scottish Chemical Market

The following notes on the Scottish Chemical Market are specially supplied to THE CHEMICAL AGE by Messrs. Charles Tennant and Co., Ltd., Glasgow, and may be accepted as representing the firm's independent and impartial opinions.

Glasgow, October 25, 1923.

BUSINESS in the heavy chemical market has been rather quiet again during the past week, the slight improvement of a week ago being apparently only temporary.

Prices both for continental and home products are on about a level with last week.

### Industrial Chemicals

ACID ACETIC, GLACIAL.—98/100%, about £60 to £65 per ton, in casks; 80% pure, £51 to £53 per ton; 80% technical £47 to £48 per ton, c.i.f. U.K. ports, duty free.

ACID BORACIC.—Crystals or granulated, £48 per ton; powdered, £50 per ton, carriage paid U.K. stations, minimum ton lots.

ACID CARBOLIC, Ice Crystals.—Price unchanged at about 1s. 2d. per lb., f.o.b. U.K. port. Moderate export inquiry.

ACID CITRIC.—B.P. crystals now offered at about 1s. 4½d. per lb., less 5 per cent.

ACID FORMIC, 85%.—Unchanged at about £49 per ton, ex store, spot delivery.

ACID HYDROCHLORIC.—In little demand. Price, 6s. 6d. per carboy, ex works.

ACID NITRIC, 80%.—£23 10s. per ton, ex station, full truck loads.

ACID OXALIC.—Slightly better inquiry. Now quoted 6d. per lb., ex store.

ACID SULPHURIC.—144°, £3 15s. per ton; 168°, £7 per ton, ex works, full truck loads. Dearsenicated quality, 20s. per ton more.

ACID TARTARIC.—B.P. crystals, unchanged at about 1s. 1d. per lb., less 5 per cent. ex store, spot delivery. Offered for early delivery at 1s. 0½d. per lb., less 5 per cent. c.i.f. U.K. port.

ALUMINA, SULPHATE.—17/18%, iron free quality, offered from Continent at £10 7s. 6d. per ton, c.i.f. U.K. ports.

ALUM, CHROME.—Quoted £24 to £27 per ton, according to quality.

ALUM POTASH (Lump).—Quoted £10 17s. 6d. per ton, f.o.b. U.K. port. Continental material offered at about £10 5s. per ton, ex store, spot delivery.

AMMONIA, ANHYDROUS.—Unchanged at about 1s. 5½d. per lb., ex station, spot delivery. Moderate export inquiry.

AMMONIA LIQUID, 880°.—Unchanged at 3d. per lb., delivered. Containers extra.

AMMONIA MURIATE.—Grey galvanisers quality unchanged at £31 to £32 per ton. Fine white crystals now quoted £23 per ton, c.i.f. U.K. port. Spot lots about £25 15s. per ton, ex store.

AMMONIA SULPHATE.—25½% material, £12 10s. 6d. per ton; 25¼% neutral quality, £14 2s. 6d. per ton, ex works. October delivery.

ARSENIC, WHITE POWDERED.—Slightly better inquiry. Quoted about £60 per ton, ex quay, early delivery. Spot lots about £65 per ton, ex store.

BARIUM CARBONATE.—98/100% prec., offered from the continent at £12 7s. 6d. per ton, c.i.f., U.K. port.

BARIUM CHLORIDE 98/100%.—English material quoted £15 per ton, ex store, spot delivery. Continental about 15s. per ton less.

BARYTES.—Finest white English unchanged at £5 5s. per ton, ex works. Good quality Continental material offered at £5 per ton, c.i.f. U.K. ports.

BLEACHING POWDER.—Spot lots, £11 5s. per ton, ex station. Contracts 20s. per ton less.

BORAX.—Granulated, £24 10s. per ton; crystal, £25 per ton; powdered, £26 per ton, carriage paid U.K. stations. Minimum ton lots.

CALCIUM CHLORIDE.—English material, £5 12s. 6d. per ton, ex station. Offered for export at about £4 10s. per ton, f.o.b. U.K. port.

COPPERAS, GREEN.—Good export inquiry. Price about £2 2s. 6d. per ton, f.o.b. U.K. ports.

COPPER SULPHATE.—Unchanged at about £25 12s. 6d. per ton, less 5%, delivered f.o.b. U.K. port.

FORMALDEHYDE 40%.—Spot material now cheaper at about £62 to £63 per ton, ex store.

GLAUBER SALTS.—Fine white crystals quoted £3 5s. per ton ex quay, spot delivery. Offered from the Continent at £2 15s. per ton, c.i.f. U.K. ports.

LEAD, RED.—English material quoted £42 per ton, carriage paid U.K. stations. Offered from Continent at about £34 per ton, c.i.f. U.K. ports. Spot lots about £36 per ton, ex store.

LEAD, WHITE.—Continental material offered at £36 per ton, c.i.f. U.K. ports, early delivery.

LEAD ACETATE.—Spot material inclined to be scarce. White crystals quoted £42 10s. per ton, ex wharf, spot delivery. Brown about £41 per ton. White crystals offered from the Continent at £39 per ton, c.i.f. U.K. port, early shipment.

MAGNESITE, CALCINED.—Finest English ground quoted £8 per ton, ex station. Offered from the Continent at about £7 5s. per ton, c.i.f. U.K. port.

MAGNESIUM CHLORIDE.—Continental material slightly cheaper at about £2 8s. per ton, c.i.f. U.K. ports, prompt shipment. Spot lots unchanged at about £3 2s. 6d. per ton, ex store.

MAGNESIUM SULPHATE (Epsom Salts).—Commercial quality offered at about £5 per ton, ex store. B.P. quality, £6 5s. per ton, ex station, prompt delivery.

POTASH, CAUSTIC 88/92%.—Unchanged at about £29 10s. per ton, c.i.f. U.K. ports. Spot lots quoted £32 per ton, ex store.

POTASSIUM BICHRIMATE.—Unchanged at 5½d. per lb., delivered.

POTASSIUM CARBONATE 96/98%.—Continental material now quoted £23 15s. per ton, c.i.f. U.K. ports. Spot lots about £27 per ton, ex store; 90/94% quality quoted £22 10s. per ton, c.i.f. U.K. port.

POTASSIUM CHLORATE.—Unchanged at about 3d. per lb.

POTASSIUM NITRATE (Saltpetre).—Offered from the Continent at about £26 per ton, c.i.f. U.K. ports. Spot lots on offer at about £30 per ton.

POTASSIUM PERMANGANATE.—B.P. crystals, spot material quoted 9½d. per lb., ex store.

POTASSIUM PRUSSATE (Yellow).—In very little demand. Now quoted 11½d. per lb., ex station, spot delivery; offered for export at slightly less.

SODA, CAUSTIC.—76/77%, £19 7s. 6d. per ton; 70/72%, £17 17s. 6d. per ton; 60/62%, broken, £19 2s. 6d. per ton; 98/99%, powdered, £22 15s. per ton; all ex station, spot delivery. Contracts, 20s. per ton less.

SODIUM ACETATE.—Price for spot lots remains unchanged at about £24 15s. per ton, ex store. Offered for early delivery from the Continent at £22 10s. per ton, c.i.f. U.K. port.

SODIUM BICARBONATE.—Refined recrystallised quality, £10 10s. per ton, ex quay or station. M.W. quality, 30s. per ton less.

SODIUM BICHRIMATE.—Unchanged at 4½d. per lb. delivered.

SODIUM CARBONATE.—Soda crystals, £5 to £5 5s. per ton, ex quay or station; alkali, 58%, £8 12s. 3d. per ton, ex quay or station.

SODIUM HYPOSULPHITE.—Commercial crystals unchanged at about £9 per ton, c.i.f. U.K. port, prompt shipment; spot lots quoted £10 per ton, ex store; pea crystals slightly higher at £14 10s. per ton, ex store.

SODIUM NITRATE.—Refined, 96/98% quality, quoted £13 5s. per ton, f.o.r. or f.o.b. U.K. port.

SODIUM NITRITE 100%.—Price £26 10s. to £28 10s. per ton, according to quantity, f.o.b. U.K. port. Moderate export inquiry.

SODIUM PRUSSATE (Yellow).—Practically no demand. Price nominally 6d. per lb., ex store.

SODIUM SULPHATE (Saltcake).—£4 per ton, ex station for home consumption. Good export inquiry.

SODIUM SULPHIDE.—60/65% solid, £14 per ton, ex station; broken, £1 per ton more; 31/34% crystals, £8 15s. per ton, ex station.

SULPHUR.—Flowers, £10 per ton; roll, £9 per ton; rock, £9 per ton; ground, £8 per ton; prices nominal.

TIN, CRYSTALS.—Unchanged at 1s. 4d. per lb.

ZINC CHLORIDE 98/100%.—Solid or powder offered from the Continent at £25 per ton, c.i.f. U.K. port. English material quoted £26 per ton, f.o.b. for export.

ZINC SULPHATE.—Offered from the Continent at about £11 5s. per ton, c.i.f. U.K. port. Spot lots quoted £14 10s. per ton, ex store.

NOTE.—The foregoing prices are for bulk business and are not to be taken as applicable to small parcels.

#### Coal Tar Intermediates and Wood Distillation Products

BENZYL CHLORIDE.—Moderate home demand. Price quoted 1s. 10d. per lb., delivered.

90's BENZOL.—Supplies are freely available. Price 1s. 4d. per gallon, ex works.

DIETHYLANILINE.—Poor demand. Price 5s. 2d. per lb., delivered.

METHYL ALCOHOL.—Prices are lower. Supplies obtainable at about £77 per ton, c.i.f.

META TOLUENEDIAMINE.—Export inquiry. Price quoted 5s. 2d. per lb., f.o.b.

NITROBENZOL.—Price weaker; 7½d. per lb., returnable drums.

PARA NITROCHLOROBENZOL.—Export inquiry. Supplies offered at £150 per ton, f.o.b.

TOLIDINE BASE.—Home demand. Price quoted 7s. per lb., 100% basis, delivered.

### Three Months of Chemical Industry

#### A Commercial Review

THE Barter Trading Corporation, Ltd., London, in their review of conditions during the past three months, state:—

Since the issue of our last quarterly report, the volume of British trade passing, especially in the textile and iron and steel groups, has been restricted. The buying power of European nations as a result of heavy depreciation of currencies has diminished. On the other hand British industries are suffering at home and abroad by the underselling rendered possible by such depreciation. Sooner or later force of circumstances may compel this country to adopt some form of protection, if only temporary, to safeguard its own home industries and maintain employment for its people and capital. After nine months' resistance at the expense of the national purse, Germany has been forced to capitulate in the Ruhr with her credit and liquid assets reduced to zero. Contributions to the resistance in the Ruhr and the appalling depreciation of the mark, so that it has ceased to be a medium of commercial value, have left German industries without effective working capital. It is impossible yet to estimate what the effect will be either in regard to reparations or world trade. Excepting that Continental offers of industrial chemicals and raw materials have diminished in number and volume, and that prices have shown a steady advance to nearly British levels in many cases, there has been nothing abnormal in the market fluctuations since we last reported. Wood distillation products are offering in increased quantities at considerably lower prices. Acetone is also becoming easier. Until the commercial fog clears our advice to consumers is to purchase cautiously and avoid undue speculation.

In coal tar products and intermediates, continued restriction in German intermediate production is diverting business to British makers for export. American reductions in petrol and other mineral oil products have affected benzol and coal tar derivatives of that class, and prices are inclined to weaken.

As to coal and coke products, restricted output in Central Europe continues to cause a fair demand for export, although supplies are freely available and concessions have been made in prices. The threatened strikes in the American fields have subsided meantime. Germany would import very largely if satisfactory credits could be arranged.

The market for fertilisers remains firm with good demand for nitrate of soda and sulphate of ammonia.

The general position in the oils, fats and waxes trade has not changed very much. Prices are fairly steady, but there are few buyers. The tallow market is firm and there is a good demand at slightly increased prices.

Increased supplies and pressure to sell have affected prices of wood distillation products, which show considerable reductions in some cases.

### The Manchester Chemical Market

(FROM OUR OWN CORRESPONDENT.)

Manchester, October 25, 1923.

LITTLE appreciable change in the general position of the chemical market here from that of recent weeks can be reported. Home trade business continues on a hand-to-mouth basis, while on export account a fair number of inquiries is being received and a quietly steady volume of business actually done. Prices have weakened here and there, but on the other hand, quotations are very firm in a few cases where supplies for spot or early delivery are pronouncedly light.

#### Heavy Chemicals

Saltcake is selling in fair quantities for shipment though the domestic position is unchanged; prices are firm at round £4 10s. per ton. Bleaching powder is steady and in moderate inquiry at £11 5s. per ton. Prussiate of soda is still a dull section of the market and quotations are easy at 5½d. to 5¾d. per lb. Caustic soda is in quietly steady demand by home users and also for shipment; prices are steady and range from £16 17s. 6d. for 60 per cent. material to £19 7s. 6d. per ton for 76-77 per cent. Hyposulphite of soda is attracting little attention and values are easier; photographic crystals are quoted at round £14 10s. per ton and commercial at £9. Glauber salts are quiet but unchanged from last week at £3 15s. to £4 per ton. Phosphate of soda is on offer at £14 10s. per ton, without arousing much buying interest. Bicarbonate of soda is being taken up in fair quantities and price is maintained at £10 10s. per ton. Sulphide of sodium is a very slow market, with values showing a further weakening tendency; current quotations are about £14 per ton for 60-65 per cent. concentrated and £8 10s. to £9 per ton for crystals. Both home and foreign demand for alkali continues on a fairly satisfactory scale, with prices steady at £7 10s. per ton for 58 per cent. material. Acetate of soda is moderately active at £24 per ton. Chlorate of soda is steady and in fair demand at 2¾d. per lb. Nitrite of soda is maintained at last week's level of £26 10s. per ton. Soda crystals are still a quiet section at about £5 5s. per ton delivered. Bichromate of soda is steady at 4½d. per lb., a fairly active demand being met with.

Caustic potash is still on offer at £29 per ton for 88-90 per cent. material, but only a moderate amount of business is being done. Carbonate of potash is rather quiet and easier at £25 for 90 per cent. and £28 per ton for 96 per cent. Yellow prussiate of potash continues dull at 11½d. to 1s. per lb. Permanganate of potash is also quiet at 9d. to 9½d. per lb. Chlorate of potash is steady and in moderate demand at 3d. per lb. Bichromate of potash is fairly active at 5¾d. per lb.

Arsenic is easier, with white powdered, Cornish makes, on offer at about £65 per ton, Manchester, foreign brands still selling at much below this figure; demand for export is quietly steady. Sulphate of copper still fails to arouse much interest, and to-day's price is about £25 10s. per ton, f.o.b. Epsom salts, commercial, are steady and in moderate request at £4 to £4 10s. per ton; magnesium sulphate, B.P., is still quoted at £6. Nitrate of lead is quiet but unchanged at £42 per ton. Spot supplies of acetates are on the short side and quotations are therefore very firmly maintained. White acetate of lead is £41 and brown £45, and acetate of lime, grey, £22, and brown, £12 10s.

#### Acids and Tar Products

Little business is being done in acids. Both tartaric and citric are quiet and easier, the former at 1s. 1½d. to 1s. 2d., and citric at 1s. 4½d. to 1s. 5d. per lb. Oxalic acid is dull but about unchanged at 5¾d. per lb. Acetic acid is in fair demand at £46 10s. per ton for 80 per cent. technical and £64 for glacial.

Pitch is firm at £6 10s. to £6 15s. per ton, Manchester, though not much business of importance is passing at the moment. Creosote oil is in moderate demand at 8½d. per gallon. Solvent naphtha is quiet but steady at 1s. 3d. to 1s. 3½d. per gallon. Carbolic acid is in short supply for early delivery and prices are more or less nominal at 3s. 8d. per gallon for crude, and 1s. 2d. per lb. for crystals. There has been little change in the position of naphthalenes, demand being quiet with prices steady; refined is still quoted at £19 to £20 and crude from £6 to £11 per ton.



## Company News

**SALAR DEL CARMEN NITRATE SYNDICATE.**—An interim dividend of 5 per cent., less tax, is announced, payable on November 2.

**AMERICAN SMELTING AND REFINING CO.**—A dividend of  $1\frac{1}{2}$  per cent. on the common stock is payable on November 1. No dividend was paid last year.

**ANGELA NITRATE CO., LTD.**—An interim dividend has been declared, at the rate of 10 per cent., or 2s. per share, less tax, payable on November 12. A year ago the interim payment was 5 per cent.

**THE MEXICAN EAGLE OIL CO., LTD.**—The directors have declared a dividend of 7s. for each ten shares on the first preference share capital of the company, payable in London on October 31.

**OLYMPIC PORTLAND CEMENT.**—An interim dividend of 5 per cent., less tax, is announced, in respect of the year 1923, payable on November 15. Twelve months ago the dividend was the same.

**ANGLO-CHILIAN NITRATE AND RAILWAY CO.**—The board has resolved to pay an interim dividend on account of the year 1923 of 1s. per preference share and 1s. per ordinary share, both free of tax, being 5 per cent. on each class, payable on November 14.

**NITRATE RAILWAYS CO., LTD.**—The directors have declared an interim dividend at the rate of  $3\frac{1}{2}$  per cent. (7s. per share), less tax, payable on November 15, on the ordinary (unconverted) and the preferred converted ordinary shares. For the past two years no dividend has been paid.

**PEASE AND PARTNERS, LTD.**—The directors have resolved to pay, on November 16, to members registered in the company's books on October 26, an interim dividend on the ordinary shares of 3 per cent., free of tax. At the corresponding period last year the interim payment was 2 per cent.

**A. AND F. PEARS, LTD.**—The profit for the year ended June last was £99,676, and £12,600 was brought forward, making a total of £112,276. A sum of £5,000 is carried to reserve, and the directors recommend a dividend on the ordinary shares at the rate of 20 per cent. per annum (same as the previous year), leaving £16,876 to be carried forward.

**BABCOCK AND WILCOX, LTD.**—The directors announce an interim dividend of 5 per cent., tax free, for the half year to June 30 last. A year ago the interim payment was 8 per cent., but the ordinary share capital has since been doubled. The present distribution is therefore equal to 10 per cent. on the old capital.

**BORAX CONSOLIDATED, LTD.**—An interim dividend of 1s. per share has been declared, less income tax at 4s. 9d. in the £, on the deferred ordinary shares, in respect of the year ending September 30 last. Coupon No. 31 of the deferred ordinary share warrants to bearer will be paid on and after November 17, at the offices of the company.

**SIAMESE TIN SYNDICATE.**—The accounts for the year 1922 show, after writing off £5,787 for depreciation, a net profit of £26,278, to which is added £1,964 brought in, making a total of £28,242. A final dividend of 5 per cent. is recommended, making 15 per cent. for the year. £2,050 is deducted for directors' additional remuneration and £6,000 for taxation, leaving £2,192 to be carried forward.

**S. AND W. BERISFORD, LTD.**—The directors recommend that a dividend at the rate of 6 per cent. per annum, less tax at 4s. 9d., be declared on the preference shares for the six months ending September 30 last, and that a final dividend of 10 per cent., less tax, at 4s. 9d., be declared upon the ordinary shares, making, with the interim dividend, 15 per cent. for the year, both payable on November 16 next. The transfer books will be closed from November 2 to November 16, both days inclusive.

**EASTERN CHEMICAL CO.**—The result of working for the year to March 31 last, after further writing down of stocks to replacement cost and allowing for depreciation, was a loss of £10,503. Serious trade depression in India, combined with keen local competition and dumping of German chemical products at prices much below world values and cost of manufacture in India, resulted in a reduced output at company's works and smaller gross profits. A good start has

been made in merchandising imported goods not manufactured in India, which promises considerable development when trade conditions improve. The directors are unable to recommend a dividend. The annual meeting will be held at 13, Fenchurch Avenue, London, E.C., on October 29, at noon.

**NORTH BROKEN HILL, LTD.**—Cabled report for the year to June 30 last, states that ore treated amounted to 171,555 tons, while 35,198 tons of lead concentrates were produced, and 32,054 tons of zinc concentrates. The total to credit of profit and loss account is £673,521, from which is deducted mine expenditure £295,236, administration, insurance, debenture interest, etc., £24,140, provision for taxes and royalties £49,365 and reserve for depreciation £20,000, leaving £284,780 carried to appropriation account. This amount, with £30,000 brought forward from last year, has been appropriated thus: Dividends Nos. 52 to 54 £180,000, debenture sinking fund £13,333, appropriation for plant expenditure £52,000, leaving a balance of £69,447. Surplus liquid assets amount to £532,454, exclusive of shares and debentures in other companies valued in the balance sheet at £448,525. With reference to the recently announced agreement with the British Australian Broken Hill, Ltd., in the event of its approval and confirmation, a resolution to increase the capital of the company to £700,000 by the creation of 100,000 additional ordinary shares of £1 each will be submitted. The directors strongly recommend the purchase of the British mine and the necessary increase of capital of the North Company.

**ELECTROLYTIC ZINC OF AUSTRALASIA CO.**—The gross profit for the year ended June 30 last, after writing £20,000 off investigational research and general development account and carrying £90,000 to reserve for depreciation, was £401,808 (against £93,841, for the preceding year, in which period the plant was only in operation for seven months). After adding £2,614, representing income from property and sundry receipts, and deducting profit and loss items, including £48,000 as provision for income taxes, the net profit was £285,406, and £76,593 was brought forward making an available balance of £361,999. This has been disposed of by writing off preference shares and debenture issue expenses, £74,482; by providing for co-operative council activities at Kisdon, £7,500; by carrying to debenture sinking fund reserve, £12,640; by carrying to equalisation reserve, £40,000; and by the payment of dividends Nos. 1 and 3, £149,115, leaving a balance of £78,262 to be carried forward. The above dividends, together with No. 4 paid in September last, cover the full amount accrued to June 30, 1923, on all preference shares issued as well as an amount representing 8 per cent. on the ordinary shares for the half-year ended June 30. The annual meeting will be held in Melbourne on October 30.

### Contracts Open

*Tenders are invited for the following articles. The latest dates for receiving tenders are, when available, given in parentheses:*

**NETHERLANDS** (October 31).—Certain chemicals and oils, soap and soap powder. Particulars from the Dept. of Oversea Trade, 35, Old Queen Street, London, S.W.1. Reference No. 20890/F.W./G.P.

**GLASGOW** (November 1).—The Corporation invite tenders for the supply of lime, cement, paints, oils, grease and soaps for six months as from December 1. Specifications and forms of tender may be had on application to Mr. W. Greig, Superintendent of Cleansing, 20, Trongate, Glasgow.

**LONDON** (November 6).—Sodium nitrate, commercial. Tender forms obtainable from the Director-General, India Store Department, Branch No. 14, Belvedere Road, Lambeth, S.E.1.

**MIDLAND GREAT WESTERN RAILWAY OF IRELAND** (November 13).—The directors are prepared to receive tenders for the supply of asbestos, cement, candles and soap, creosote oil, drysalteries, grease, lime, oils, paints, colours, varnishes. Forms of tender can be obtained from the Storekeeper, General Stores Department, Broadstone Station, Dublin.

**EGYPT** (November 15).—Calcium carbide, candles, etc. Particulars from the Dept. of Overseas Trade, 35, Old Queen Street, London, S.W.1. Reference No. 11723/F.E./G.C. (2s)

# THE BRITISH ALIZARINE COMPANY LTD.

**Manchester**

**London**

## Manufacturers of Alizarine Dyestuffs

ALIZARINE RED  
(all shades)

ALIZARINE BORDEAUX

ALIZARINE GREEN  
(soluble and insoluble)

ALIZARINE RED S. POWDER

ALIZARINE (MADDER) LAKES  
(of all qualities)

ALIZUROL GREEN  
(Viridine)

ALIZANTHRENE BLUE

ALIZANTHRENE YELLOW

Other fast colours of this series in course of preparation

Anthraquinone, Silver Salt and all intermediates of this series

CHROME TANNING and other Chrome Compounds

ALIZARINE BLUES  
(soluble and insoluble)

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ALIZARINE ORANGE

ALIZARINE BLUE BLACK

ALIZARINE MAROON

ANTHRACENE BROWN

ALIZANTHRENE BROWN

TELEPHONES  
663 Trafford Park, MANCHESTER  
560 EAST LONDON  
2667 DOUGLAS, GLASGOW

TELEGRAMS  
BRITALIE MANCHESTER  
BRITALIZ LONDON  
BRITALIZ GLASGOW

All communications should be  
addressed to  
The British Alizarine Co., Ltd.  
Trafford Park, Manchester

## Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

### County Court Judgments

[NOTE.—The publication of extracts from the "Registry of County Court Judgments" does not imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be for damages or otherwise, and the result of bona-fide contested actions. But the Registry makes no distinction of the cases. Judgments are not returned to the Registry if satisfied in the Court books within twenty-one days. When a debtor has made arrangements with his creditors we do not report subsequent County Court judgments against him.]

HUMBER CHEMICAL CO., 23, North Walls, Hull, chemical manufacturers. (C.C., 27/10/23.) £18 16s. 6d. September 21.

STANFIELD, Mr. J. L., Booth Fold, Waterfoot, chemical manufacturer. (C.C., 27/10/23.) £10 13s. 3d. September 21.

TURNER DRUG AND GALENICAL CO., LTD., Roden Street, Ilford. (C.C., 27/10/23.) £86 19s. 4d. July 3.

### Receivership

IMPROVED SOLIDITE CO., LTD. (R., 27/10/23.) H. W. McLaren, of 68, Coleman Street, E.C., ceased to act as receiver or manager on October 16, 1923.

### Mortgages and Charges

[NOTE.—The Companies Consolidation Act, of 1908, provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an \*—followed by the date of the Summary, but such total may have been reduced.]

BORAX CONSOLIDATED, LTD., London, E.C. (M., 27/10/23.) Registered October 12, Trust Deed dated October 9, 1923 (supplemental to Trust Deed dated October 10, 1912), securing £100,000 further 2nd debenture stock; charged on same property as by original Trust Deed. \*£1,916,450. March 1, 1923.

CATALYTIC CHEMICAL CO., LTD., Southall. (M., 27/10/23.) Registered October 9, £1,000 debentures; general charge. \*£9,600. January 13, 1923.

COLEBY, LTD., London, E., chemists. (M., 27/10/23.) Registered October 12, £10,500 debentures; general charge. \*Nil. December 31, 1922.

EXPRESS DYEING AND CLEANING CO., LTD., London, W. (M., 27/10/23.) Registered October 11, £500 (not ex.) charge, to Lloyds Bank, Ltd.; charged on Express Works, Northfield Road, Ealing.

SYNTHETIC PRODUCTS CO., LTD., London, E.C. (M., 27/10/23.) Registered October 13, £5,000 (not ex.) debenture, to King's Lynn Milling Co., Ltd., Alexandra Dock, King's Lynn; general charge. \*£16,155 9s. 8d. February 17, 1922.

### Satisfaction

WYKE DYEING CO., LTD., Bradford. (M.S., 27/10/23.) Satisfaction registered October 11, £1,500, registered December 23, 1922.

### London Gazette

#### Notices of Intended Dividends

JOHN, Edward Arthur, 5, Talbot Street and Talbot Lane, Cardiff, condiment manufacturer. Last day for receiving proofs, November 3. Trustee, E. Owen, Official Receiver, 34, Park Place, Cardiff.

MYER, Robert Henry, carrying on business as The ROSS SUPPLY CO., 186, Wandsworth Road, London, S.W.8, manufacturing perfumer. Last day for receiving proofs, November 2. Trustee, David Hart, 5, Argyll Street, Oxford Street, London, W.

### Companies Winding Up Voluntarily

INDUSTRIAL SOAP CO., LTD. (C.W.U.V., 27/10/23.) Frank Binns, of 35, Westgate, Huddersfield, chartered accountant, appointed liquidator.

PHOSALINE, LTD. (C.W.U.V., 27/10/23.) T. R. Gleaves, of the Wardwick, Derby, chartered accountant, appointed liquidator. Meeting of creditors at the offices of Oswald Ling, Gleaves and Co., 51, Wardwick, Derby, on Thursday, November 8, 1923, at 3 p.m.

SHILVOCK, SON AND CO., LTD. (C.W.U.V., 27/10/23.)—D. A. Spire, 493, New Cross Road, London, S.E.14, appointed liquidator. Meeting of creditors at the liquidator's office, on Tuesday, November 6, at 11.30 a.m.

### Partnership Dissolved

THE UNIVERSAL DYE WORKS (Herbert MOORE and Thomas William Moore), dyers, at, Coombe Street, Coventry, by mutual consent as from October 13, 1923. All debts received and paid by H. Moore.

### Bankruptcy Information

STANSFIELD, John Lord, Boothfold, Waterfoot, Bacup, Lancs, chemical manufacturer. First meeting, November 1, 3 p.m. Official Receiver's Offices, Byrom Street, Manchester. Public examination, November 30, 2 p.m. County Police Court, Buckley Place, Rochdale.

### New Companies Registered

ABBEY WORKS, LTD., Abbey Works, High Street, Hanley, Staffs. China and earthenware manufacturers, manufacturers of and dealers in colours, clays, chemicals, etc. Nominal Capital, £100 in £1 shares.

DEBY, BARRETT AND CO., LTD., 39, Victoria Street, London, S.W. Constructional engineers, dealers in chemicals, minerals, etc. Nominal capital, £5,000 in £1 shares.

NORTHERN SMELTLESS FUELS, LTD. Manufacturers of and dealers in briquettes and patent fuels, chemical manufacturers, manufacturers of and dealers in the products from metals and minerals, etc. Nominal capital, £2,000 in £1 shares. A subscriber: H. W. Fenney, 54, Gresham Street, London, E.C.2.

STUART, ROY AND CO., LTD., The Hill, Barlaston, Staffs. Manufacturers, producers, quarriers, refiners of and dealers in chemicals, minerals, salts, acids, alkalis, drugs or manures of every description, etc. Nominal capital, £100 in 1s. shares.

D. WALDIE AND CO. (LONDON), LTD., 62, London Wall, London, E.C. Chemical acid and fertiliser manufacturers, drysalts, oil and colourmen, manufacturers of and dealers in essential oils, etc. Nominal capital, £2,000 in £1 shares.

WARRINGTON PRODUCTS CO., LTD. Manufacturers of and dealers in animal products, hides, manures, fertilisers, disinfectants, soaps, oils, fats, salts, acids and alkalis. Nominal capital, £2,000 in £1 shares. Solicitor: E. A. Connor, 11, Mill Street, Warrington.

### The Making of Wealth

UNDER the auspices of the Industrial League and Council at Caxton Hall, London, on Wednesday, Sir Ernest J. P. Benn spoke on the subject of "The Making of Wealth." Taking Mr. Ramsay Macdonald's definition of socialism as the control of the economic circumstances of life, he claimed that M. Poincaré was the prince of socialists. He was, from a totally different reason, supplying remedies which were in essence socialism. M. Poincaré, however, differed from most socialists in that he had the wisdom to force these schemes on his enemies instead of on his friends.

### British Industries Fair

UNITED KINGDOM firms considering participation in next year's British Industries Fair are advised to send in their applications for space as early as possible, as numerous applications from prospective exhibitors have already been received by the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1.



